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EIGHTH ANNUAL REPORT

OF

THE RESEARCH DEPARTMENT

OF THE

COFFEE BOARD

1954-55

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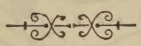
COFFEE BOARD

RESEARCH DEPARTMENT

EIGHTH ANNUAL REPORT OF THE RESEARCH DEPARTMENT

(July 1954 to June 1955)



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Map of the
COFFEE RESEARCH STATION
BALEHONNUR
(CHIKMAGALUR DIST. — — MYSORE STATE)

- OFFICE BUILDINGS & REST HOUSES
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COFFEE BOARD

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1954-1955

INTRODUCTORY

PART I

ADMINISTRATION

I was in charge of the Research Department throughout the year. Sri S. Visvesvara, M.Sc., was appointed as Asst. Botanist with effect from 8-7-1954. There was no other change in the personnel of the Officers in the technical and liaison divisions of the Department. The following Officers continued to hold charge of the posts shown against them:

Dr N. G. Chokkanna	*Chemist*
Sri R. L. Narasimhaswamy	*Botanist*
Dr S. A. Raja Rao	*Entomologist*
Sri K. V. George	*Mycologist*
Sri P. K. Mathew	*Asst. Chemist*
Sri K. B. Ponnappa	*Secretary to Director of Research*
Sri T. V. Pattabhiraman	*Senior Liaison Officer*
Sri G. I. D'Souza	*Junior Liaison Officer*
Sri H. S. Puttuswamy	,,
Sri W. Raghavendra Rao	,,
Sri K. T. Bhagat	,,
Sri S. J. Mathias	,,
Sri B. K. Chandrappa	,,
Sri R. Vijaendraswamy	,,

Sri James Colaco continued to be the Superintendent of the Coffee Research Sub-Station, Chethalli (Coorg), until he went on earned leave for 43 days from 19-11-1954. He was, on return from leave on 1-1-1955, placed on special duty at the Coffee Research Station, Balehonnur (Mysore State), and was subsequently on 3-2-1955 transferred as Superintendent, Coffee Research Station, Balehonnur. He finally reverted to the parent Government (Madras) from 14-3-1955. During the period of absence of Sri Colaco on leave, Sri T. V. Pattabhiraman, Senior Liaison Officer stationed at the Coffee Research Sub-Station, Chethalli, held full additional charge of the duties of the Superintendent, Coffee Research Sub-Station. The latter was relieved of the charge on 5-2-1955 by Sri K. B. Ponnappa, Secretary to the Director of Research, as an emergency measure in connection with the developing of a sound labour and employer relationship in the Station and release the Senior Liaison Officer to carry out urgent liaison work.

Extension Service: In addition to the overall direction and supervision of the liaison service, I held direct supervisory charge of the liaison divisions in the Mysore State and the Shevaroys. Sri T. V. Pattabhiraman, Senior Liaison Officer, held supervisory charge over the Liaison Divisions of Nilgiri-Wynaad and North Coorg. He held direct charge of the South Coorg Division and the Coimbatore Division comprising of Anamallais, Nelliampathies, Pulneys and Travancore-Cochin State. The Junior Liaison Officers who completed their training during the year were posted to the different zones and continued to work at headquarters shown against them:

Sri G. I. D'Souza	Chikmagalur (Mysore)
Sri H. S. Puttuswamy	Mudigere ,,
Sri W. Raghavendra Rao	Saklespur ,,
Sri K. T. Bhagat	Somwarpet (N. Coorg)
Sri S. J. Mathias	Kalpetta (Malabar–Wynaad)
Sri B. K. Chandrappa	Yercaud (Salem–Madras)

Sri R. Vijaendraswamy, Junior Liaison Officer, was under training throughout the year at the Research Stations and selected private estates. From April 1955, he was on further training at the Coffee Research Sub-Station in estate management and labour relations.

Staff: The sanctioned strength of the Departmental Officers and staff were 2 in the Administration, 31 in the Technological sections, 29 in the Liaison Section, 17 in the Ministerial Section and 6 in the Farm or Estate Section. The vacant post of Agronomist was advertised calling for candidates twice during the year as also those of Research Assistants in Chemistry and Plant Pathology, Superintendent and Junior Liaison Officer. Applications received for them are pending final selection.

Two posts of clerks and 20 posts of fieldmen were vacant at the end of the year and have been advertised. Applications are under consideration for final selection.

Appointments and Transfers: The following appointments of staff were made during the year:

1. Sri C. K. Vasudevan, B.Sc. Ag., as Research Assistant in Plant Protection with effect from 19-7-1954.
2. Sri A. R. Krishnaswamy, B.Sc., D.I.H., as Research Asst. in Botany with effect from 19-7-1954.
3. Sri B. R. Ananth, B.Sc., as Research Assistant in Chemistry with effect from 28-7-1955.

4. Sri K. M. Srinivasamurthy as Junior Clerk Typist with effect from 2-7-1954.
5. Sri G. B. Gopalachar as Fieldman with effect from 25-7-1954.
6. Sri M. Suryanarayana Mallya as Temporary Junior Clerk with effect from 4-4-1955 for 3 months.
7. Sri C. Sarangan as Junior Clerk with effect from 25-4-1955.

Sri T. H. Thimme Gowda, Farm Assistant at the Coffee Research Station, Balehonnur, was transferred temporarily as Farm Assistant at the Coffee Research Sub-Station, Chethalli, with effect from 4-2-1955. Sri B. B. Joyappa, Fieldman, Coffee Research Station, was transferred to Coffee Research Sub-Station with effect from 1-11-1954. Sri A. T. Chengappa, Fieldman, Coffee Research Sub-Station, was transferred to the Balehonnur Station.

Leave: The following officers were on earned leave for periods noted against them during the year:

1.	Dr N. G. Chokkanna, Chemist	...	31 days
2.	Dr S. A. Raja Rao, Entomologist	...	2 ,,
3.	Sri P. K. Mathew, Assist. Chemist	...	39 ,,
4.	Sri W. Raghavendra Rao, Jr. Liaison Officer	...	19 ,,
5.	Sri G. I. D'Souza ,, ,,	...	18 ,,
6.	Sri S. J. Mathias ,, ,,	...	11 ,,
7.	Sri K. T. Bhagat, Jr. Liaison Officer	...	30 ,,
8.	Sri James Colaco, Superintendent	...	43 ,,

Sri S. Visvesvara, Assistant Botanist, was on extraordinary leave for 19 days from 5-8-1954.

Tour: I was on tour for 197 days in the year to attend the meetings of the committees of the Board in Bangalore and to visit coffee areas in Coorg, Mysore, Shevaroys, Wynaad and Nilgiris on both exploratory and advisory work. I visited 130 big and an equal number of small estates. The Sub-Station at Chethalli was visited 8 times during the year covering a halt of 30 days.

Dr N. G. Chokkanna, Chemist, was on tour for 111 days in the coffee areas in Mysore, Coorg and Nilgiris in connection with advisory work in problem areas on soil management and nutritional requirements, and exploratory work on the field manurial trials at the Research Stations and private estates.

Sri R. L. Narasimhaswamy, Botanist, was on tour for 77 days to visit registered estates in Mysore, Coorg, Shevaroys and Nilgiris for marking of plants of Station Selections for seed purposes, for collection of plant material of outstanding performance for planting at the Research Stations for future work and for advisory work on propagation in problem areas.

Sri T. V. Pattabhiraman, Senior Liaison Officer, was on tour for 143 days to establish contacts with planters and to renew contacts and to make follow-up visits on advisory programmes both on zonal and general problems. He visited 156 estates and contacted groups of planters in many of the centres.

Dr S. A. Raja Rao, Entomologist, was on tour for 44 days to visit private estates and the Sub-Station at Chethalli on exploratory service in connection with field trials on pest control.

Sri K. V. George, Mycologist, toured for 22 days to visit problem areas on disease control.

The Research Assistants and Field personnel in the several technological sections were deputed to experimental and problem blocks in the different zones for execution of programmes.

The following table summarises the number of days on tour, the estates visited and planters contacted by the Junior Liaison Officers during the year under report.

	No. of days on Tour	*No. of Estates Visited*	*No. of Planters Contacted*
Junior Liaison Officer, Chikmagalur	301	353	400
,, Saklespur ...	232	252	450
,, Kalpetta ...	280	319	1500
,, Somwarpet ...	250	225	300
,, Yercaud ...	197	85	400
,, Mudigere ...	218	319	350

Construction of Buildings: In pursuance of the programme of construction of living quarters for the staff and labour, and expansion of laboratory and storage accommodation, a Seed Chamber was newly constructed and two labour lines were remodelled to suit the requirements under the Labour Laws. Construction of 4 Senior Staff quarters, 2 twin type Junior Staff quarters was started. Works contemplated to be completed in the year could only be taken up as part works on account of a drastic cut in the provision for capital expenditure under works by over Rs 70,000. This has necessitated a deferring of the major programme of construction of staff quarters to the next financial year.

Construction of a Field Laboratory and one wing of a twin type Junior staff quarters was completed at the Coffee Research Sub-Station, Chethalli, during the year.

In view of the limited time available for constructional operation in the localities where these Stations are situated, it has become necessary to redraw the programme of housing to extend over a period of two or three years.

The total expenditure on this account was Rs 68,000 at the Main Station at Balehonnur and Rs 37,000 at the Sub-Station at Chethalli during the year under report.

Library: Three new journals were added to the library by subscription and one additional journal was being received on exchange basis bringing the total number of journals received at the library to 65 (46 by subscription and 19 on exchange basis). 79 books were added to the reference section bringing the total collection to 708 at the end of the year. 50 volumes of loose journals were got bound.

Meetings: I attended two meetings of the Board at Bangalore and three meetings of the Research Committee, one of which was held at the Coffee Research Station, Balehonnur. Two *ad hoc* committee meetings at the main Station at Balehonnur and three meetings at the Sub-Station at Chethalli were also attended and conducted.

Four meetings of the staff were held at the Coffee Research Station, Balehonnur, to discuss and review programme of research, extension and administrative matters and related subjects during the year. Informal meetings with Heads of Technological Sections and Field Staff were held once a month at Balehonnur and four times at the Sub-Station, Chethalli, during the year.

Ad hoc **Committees:** Mr R. Radcliffe, who was a member of the *ad hoc* committee of the Balehonnur Station for over 4 years, having resigned his membership of the committee owing to pressure of work elsewhere, Mr E. J. H. Morgan was appointed in his place. Sri M. S. Dyave Gowda, Sri K. A. Aiyappa and Sri M. Hutche Gowda continued to serve on the committee throughout the year.

Mr C. L. J. Humphreys and Sri G. M. Manjanathayya continued to be the members of the *ad hoc* committee at the Chethalli Sub-Station during the

year. Major B. S. Bucknall, a member of the *ad hoc* committee at Chethalli went on home leave from July 1954. Sri D. V. Dasappa was appointed as a member of the committee in place of Major Bucknall.

I would like to express my deep sense of gratitude to all the members of the committees for their very valued advice and assistance in the management of the estates of these two Stations. To Mr R. Radcliffe, a special tribute has to be paid for the practical guidance he gave to our discussions.

Major Bucknall died suddenly, while on home leave in England, to the great sorrow of all those who were associated with him. His death has left a sense of void which is hard to fill; but his energetic recommendations are still with us and guide our plans in upgrading our estates in which he took so much personal and untiring interest.

Visiting Agents: The Visiting Agent for the Balehonnur Station, Sri K. A. Aiyappa, Manager, Merthikhan Estate, paid 8 visits to the Station. Major B. S. Bucknall, Visiting Agent of the Coffee Research Sub-Station, Chethalli, visited the Sub-Station twice before he left on home leave in July 1954. Sri K. L. Bhandari, Manager, Nullore Group Estates, South Coorg, was appointed as the Visiting Agent of the Sub-Station in place of Major Bucknall and he paid 8 visits to the Station during the rest of the year.

I am deeply grateful to all of them for their selfless and disinterested service. Their visits have been particularly useful to us for the very valuable exchange of ideas that has resulted from them.

Exhibition and Conference: I attended the Annual Scientific Conference of the U.P.A.S.I., at Coonoor in August 1954, and the Entomologist and myself took part in the discussion on plant protection equipment initiated at the Scientific Conference. The Department participated in the Exhibition at that time.

The Department also participated in the Exhibition arranged in connection with the second All India Malnad Conference held at Mercara in May 1955.

I attended the meetings of the Mysore Planters' Association and Indian Planters' Association, Chikmagalur, and an informal meeting of the Shevaroy Planters at Yercaud. I addressed these meetings on technological aspects of soil management, plant protection and shade regulation and held discussions with groups of planters.

Correspondence: The number of letters dealt with during the year are as follows:

	Balehonnur	*Chethalli*
Inward	10,095	2,925
Outward	12,835	3,727

The increase of over 30 per cent in inward communications reflected the awareness of the planter for technological improvement and his desire to make use of the technical advances for crop and soil husbandry. More than 50 per cent of the letters sent outward related to advisory correspondence.

Audit of Accounts: The audit of accounts for the year 1953-54 of Coffee Research Station, Balehonnur, and Coffee Research Sub-Station, Chethalli, were conducted in the months of January and March 1955. The Accounts Officer of the Coffee Board also conducted an interim check of the accounts of both the Stations once during the year.

Budget: The budget for the year anticipated a programme of expenditure of Rs 2,26,000 under Capital inclusive of works and Rs 4,58,900 under Recurring inclusive of estate maintenance. The programme however was modified to a

considerable extent on account of reduction in grants of nearly Rs 76,000 under Capital and Rs 46,000 under Recurring. An actual expenditure of Rs 1,56,000 under Capital including works and Rs 3,99,300 under Recurring including estates was incurred. The budget for the year 1955-56 anticipates an expenditure of Rs 2,27,000 on Capital Expenditure inclusive of buildings and Rs 4,96,600 on Recurring Expenditure, the Liaison Section alone accounting for a considerable increase in expenditure both on establishment and demonstration and exploratory work in the field. The revenue receipts for the year showed an all high figure of Rs 1,82,401 against a revised anticipated income of Rs 1,54,200 the higher rates of dividend for the earlier crop of 1953-54 accounting for a large portion of this increase in revenue. A receipt of Rs 1,52, 500 has again been estimated for the year 1955-56.

Visits: The Coffee Research Station at Balehonnur had the privilege of receiving over 60c planters and others interested in the planting industry. It was particularly pleasing and encouraging to note that groups of small planters made frequent visits to the Station either with the Liaison Officers of their jurisdiction or of their own accord.

The year under report also saw many distinguished visitors both from the Governmental and Public sectors.

Sri Ajit Prasad Jain, Union Minister for Food and Agriculture; Sri H. Siddaveerappa, Minister for Home, Mysore State and Chairman of the Coffee Board; Sri Kadidal Manjappa, Minister for Revenue, Mysore State; Sri H. C. Dasappa, M.P., Dr R. Nagana Gowda, Minister for Forests and Agriculture, Mysore State; Sri H. M. Channabasappa, Minister for Industries, Mysore State; Sri S. V. Krishnamoorthy Rao, Deputy Chairman of the Rajya Sabha; Sri M. Manjuran, M.P.; Sri N. P. Damodharan, M.P., and Sri B. P. Basappa Setty, M.P., honoured the Station with a visit.

Sri S. N. Ramanna, Vice-Chairman of the Coffee Board and Sri K. H. Srinivasan, Retd. Director of Agriculture, Mysore State, again visited the Station during the year under report and made encouraging suggestions for the improvement of the estate.

Chethalli: The year again saw an increasing number of visitors of planters and others interested in planting. 300 small selected planters and land holders led by the Project Officers of the several Community Project Units visited the Station in batches of thirties. These visits were particularly welcome in that they gave an opportunity of establishing close contact with the small planters. The Station had the honour of receiving Sri Ajit Prasad Jain, Union Minister for Food and Agriculture; Sri Punjabarao Deshmukh, Union Minister for Agriculture and Sri M. V. Krishnappa, Union Deputy Minister for Food and Agriculture during the year.

The Department is particularly grateful to Col. Dayasingh Bedi, Chief Commissioner for Coorg, Sri C. M. Poonacha, Chief Minister for Coorg and Sri K. M. Mallappa, Home Minister for Coorg, for their frequent visits to the Station and the continued interest evinced by them in its well-being.

Plantation Enquiry Commission: The Plantation Enquiry Commission headed by Sri P. Madhava Menon, I.C.S., Chairman, and Sri K. G. Sivaswamy and Prof. M. V. Mathur, members, visited the two Stations of the Department, and discussed problems of coffee cultivation with special reference to the cost structure and labour-employer relationship. During their two days stay at the Coffee Research Station, Balehonnur, they visited the laboratories and the field experimental blocks and neighbouring small and big estates. They made a special enquiry of the liaison-approach to planters and in particular of the increasing demand of the planter for advisory service and his readiness to avail of the technical advances in coffee culture.

Their sojourn in the coffee areas of Saklespur, Coorg, Wynaad, Nilgiris, Shevaroys and Pulneys, included visits to big and small coffee estates and they were accompanied by the respective liaison staff during their visit to these areas.

Sri K. H. Srinivasan and Sri S. N. Ramanna accompanied the Commission during their visit to the Coffee Research Station, Balehonnur, and Mysore areas.

Annual Celebrations: The Independence Day and the Republic Day were celebrated at both the Stations. The labour force was granted holidays with wages on these days and entertained to sports and refreshment.

Exchange of seed material: The Station is indebted to the following persons and institutions for sending valuable coffee and other seed and seedling material:

1. Director, UNESCO, Monrovia, Liberia.
2. Director, Institute National Pour L'Etude Agronomique Du Congo Belge, Station De Mulungu—Tshibinda .
3. Principal, School of Agriculture, Peradeniya, Ceylon.
4. Director, De La Section Technique D'Agriculture, Tropicale, 27 Rue, Oudinot, 27-Paris. (*7e*).
5. Senior Research Officer, Coffee Research and Experimental Station, Lyamungu, Moshi, Tanganyika Territory.
6. Head, Plant Pathology Department, Estacao Agronomica Nacional, Sacavem, Portugal.

Publications: Popular notes on technological problems of immediate interest to planters were issued during the year on the following subjects and published in the *Indian Coffee*.

1. A brief note on Coffee Grafting.
2. Circular Notes on supply of coffee seeds from Station Selections and their care in seed bed and nursery.
3. Questions and Answers on the incidence and control of Green Bug.
4. Common and uncommon diseases and pests of coffee.
5. A brief note on shade trees for arabica coffee.
6. A further part of the note on Coffee Culture prepared as a compendium of information from all sources was issued during the year.
7. Travelogues and observational notes on zonal problems in the Liaison Divisions included the following:
   (*a*) Musings on Borer Damage in the Bababudan Giris by G. I. D'Souza.
   (*b*) Weeds commonly found in coffee estates in Mudigere zone by H. S. Puttuswamy.

A brief note on work done by the Research Department in 1954-55 was prepared and sent to the Ministry of Commerce and Industry, Government of India, and a technological synopsis of research programme of the Department was prepared and sent to the Ministry of Food and Agriculture, Government of India.

Training in Coffee Culture: In response to an increasing demand from planters, planting corporations and others interested in the coffee industry, the Board sanctioned, at the instance of the Research Committee, a scheme of training in coffee culture of not more than six candidates a year. This training was intended to cover a period of three months and in two phases of six to ten weeks to give an intensive insight into the basic essentials of coffee growing and the latest technical advances in its culture. Special emphasis was also laid on the cost structure and the maximum effective use of labour turn-out with reference to seasonal operations. Under this scheme, a nominee of The Tea

Estates (India) Ltd., was trained during the year. It is encouraging to note that quite a few enquiries have been received from State Governments, Associations and individual planters for deputing their candidates, and this demand indicates the usefulness of this course of training. It may be stated in passing that this association has been equally useful to the Department in that it has established a close contact with the managerial portion of the private estates and has greatly smoothened the liaison contacts in those areas. Applications from foreign Governments for such training are also under consideration.

FIELD STATIONS

There was a slight change in the supervisory personnel of the two estates of the Department.

Sri James Colaco, B.Sc. (Agr.) Superintendent, Coffee Research Sub-Station, was transferred as Superintendent of the Main Station at Balehonnur early in January 1955. He later elected to revert to his parent Department of Agriculture, Madras State, from March 1955 when Sri H. Hanumantha Rao, Agronomy Assistant, was placed in additional charge of the duties of the Farm Assistant for the rest of the year.

Sri T. H. Thimme Gowda, Farm Assistant at Balehonnur, was transferred to Chethalli from February 1955.

Season and Crop

Balehonnur: The total rainfall during the year was 129.60 inches (from July 1954 to June 1955) against an annual average of 108.23 inches during the decennial 1945-1954. Precipitation was nearly 17 inches less than the previous year though it was more by 21 inches than the decennial average. It was interesting to note that precipitation was spread practically throughout the year excepting the two months of November and January in contrast to the normal four to five months of dry period usually noticed in these parts. The South West Monsoon commenced in a steady manner early in the beginning of June and gathering strength continued to be plentful and timely.

An unexpected precipitation of 77 cents in December 1954 caused a small dropping of ripe fruits. A rainfall of 25 cents in February resulted in the opening of a negligible blossom both in robusta and arabica. Actually, arabica profited by this shower.

A copious blossom shower of 1.80 inches in the third week of March with plentiful backing showers in April and May was again an encouraging sign of assured crop. The month of May, however, recorded heavy and unexpected downpours, a precipitation of 15.28 inches being recorded over a period of 48 hours in a total of 17.94 inches for the whole of the month. This rainfall in May constitutes a record in the known history of this Station.

The South West Monsoon of 1955 commenced early in the beginning of June and showed every sign of a satisfactory season.

A crop of 20.5 tons was harvested during the crop year 1954-55 against an estimate of 16.5 tons and against 19.45 tons of crop harvested during 1953-54. Estimates on blossom and post-blossom settings set the crop at 18.75 tons for 1955-56 crop year. It is interesting to observe that the crop yields on this estate have begun to even out in spite of reduced bearing acreage from 110 acres in 1953-54 and the earlier years to 95 acres in the crop year 1954-55.

The average yields on bearing area rose from 2.61 cwt., in 1951-52 to 3.54 cwt. in 1953-54 and 4.53 cwt., in 1954-55.

Chethalli: The total rainfall received during the period under report was 81.74 inches against 87.74 inches recorded in the previous year and a fifteen year average of 73.45 inches.

The year again saw a repetition of frequent and uncertain pre-blossom showers. 44 cents received in February accounted for 5 per cent of the blossoms 33 cents in the first fortnight of March forced out 60 per cent and 82 cents in the third week of March brought out the balance of the blossoms. Nevertheless, good backing showers in April and obvious backing effect of the later showers in March on the early blossoms minimised the evil effects to some small extent.

Surprisingly, 15 tons of crop were harvested in the year under report against an estimate of 12 tons. The crop estimate on the blossoms and the post-blossom settings are set at 14 tons for the year 1955-56.

As in the earlier case at the Main Station at Balehonnur, definite signs are noticeable at Chethalli also of the production of an average even crop annually.

Pests and Diseases

Balehonnur: The year saw a heavy incidence of leaf disease in spite of protective measures taken as early as May—June 1954 when, because of seasonal climatic conditions, a more than an average out-break was anticipated. Disease conditions, which started activity in May-June, persisted even during the monsoon months of July, August and September and caused severe leaf-shedding. This helped in stemming the ravage in the latter part of the year. A post-monsoon spray in September and a tip spray in late October helped to stop the further spread of the disease, and it was heartening to note that the plants showed visible signs of recovery by the end of November.

Though prospects for the year 1955 also appear to be gloomy because of the short dry period and the continued humid, cloudy and rainy days in the summer months, leaf disease intensity was not much in evidence till the middle of June. Pre-monsoon protective operations also helped in controlling the spread.

Black-rot occurred in patches to an inconsiderable extent and immediate control operations confined the disease.

Infestation with stem borer, judged from number of plants removed or stumped, was as low as 1.34 per cent of the total plant population in the estate. Against an average of 5,000 plants removed or stumped during the lustrum ending 1953-54, the actuals for the year 1954-55 were as low as 1647.

A regular programme of rigid tracing of borer and removal of bored plants and an equally regular timely protection in the two flight seasons by stem-washing with Benzene hexachloride formulations obviously helped in the control of this pest.

The incidence of green bug continued to be low and was noticed scattered in small blocks all over the estate. The entomogenous fungi were active during the monsoon periods and the entomogenous insect parasite (*Cocophagus bogoriensis, köre*) during the summer months and thus helped in confining the incidence of this pest.

Shot-hole borer on robusta was fairly evident, though not in a severe form. Cultural method of control by pruning and regulated feeding helped in reducing infestation.

There was no major incidence of other pests and diseases.

Chethalli: Leaf disease appeared, as in the earlier year, in a comparatively mild form, but became particularly visible in the older coffee blocks as the season advanced. Leaf-shedding was also severe in patches during the monsoon and post-monsoon periods. Again, as at Balehonnur, surprisingly there was a spectacular recovery of the plants in late October—November. A pre-monsoon spraying in May and a post-monsoon spraying in September—October were undertaken. A tip spray early in June to the young clearings was also given.

The estate was particularly free from black-rot and other minor diseases.

A regular programme of chemical control of white-stem borer together with a rigid tracing of bored plants and their removal and destruction started in 1953 began to show satisfactory responses. 1190 plants were marked and uprooted

in July—September 1954 prior to the long emergence season. In March—June, the number came down to as low as 240 over an area of 120 acres against 2,540 and 2,050 in respective periods of the previous year.

General

Both Stations continued to be members of the U.P.A.S.I., and of the Regional Planters' Associations. Chethalli Station was a member of Coorg Orange Growers' Co-operative Society also.

Labour: Labour strength at Balehonnur which was 153 at the beginning of the year under report rose to 155 at the end of that period against a sanctioned strength of 170. At Chethalli, the year started with 128 on the check-roll and decreased to 110 at the end of the year.

While labour-employer relationship continued to be cordial and happy at Balehonnur, the situation at Chethalli gave cause for much anxiety during most part of the year. Thanks to the very wise counsels of the leaders of both labour and employers and the commendable restraint shown during greatest stress, the situation eased considerably by the end of the year and normal relationships have been almost restored.

Serious consideration is being paid to ways and means of obtaining a cordial and workable labour-employer relationship.

The average turn-out of labour at Balehonnur was 72.5 per cent varying from 68.0 to 79.0 per cent according to seasonal necessities.

It is of interest to note that, in spite of unrest among labour, the average turn-out at Chethalli was in the region of 75 per cent during most part of the year.

Medical facilities: Medical facilities were provided by part-time services of the local Officers of the Mysore and Coorg State Administration.

A qualified mid-wife was posted at the Research Station, Balehonnur, by the Mysore Health Department.

The local anti-malarial squads attended to D.D.T. spraying of all estate quarters at both the Stations.

Dispensaries were run to issue stock medicines as prescribed by the Visiting Doctors. A total of Rs 2,540 at Balehonnur and of Rs 1,393 at Chethalli was spent on this account inclusive of maternity allowance.

Harvest: The following table summarizes the yield of uncured coffee harvested during the year under report:

Yield of coffee in bushels (uncured)

	BALEHONNUR		CHETHALLI		
	Arabica *Bushels*	Robusta *Bushels*	Arabica *Bushels*	Robusta *Bushels*	Totals *Bls.*
A. Parchment	861.0	111.0	654.0		1,626.0
B. Cherry	633.0	264.0	720.0	82.0	1,699.0
C. Gleanings and bits	135.0	35.0	62.0	1.5	233.5
D. Others inclusive of seed	63.0	36.0	34.0		133.0
Total	1,692.0	446.0	1,470.0	83.5	3,691.5
Estimated yield of clean coffee for 1955-56		18.75 Tons		14 Tons	

Replanting and New Clearing

Balehonnur: In furtherance of the policy of replacing old, uneconomical and pest ridden coffee, a further 8 acres were replanted. The area so cleared was utilized to form a seed block of promising Station Selections S.795, S.947, S.645, S.532 and S.846 and to extend protective lines of the manurial experiments.

A further 2.5 acres of old coffee was uprooted and replanted to world collections.

4.5 acres of isolated jungle were felled, cleared and prepared to plant to Station Selections to develop a protected seed block.

Chethalli: 4 acres of jungle land cleared during the earlier year were planted to robusta under manurial experiments.

1.5 acres were planted to demonstrate a combined hedge-row terrace planting of arabica coffee.

Nearly 17 acres of jungle were being cleared to lay down a trial to study the compatability and comparative suitability of common shades for coffee.

It is interesting to note that while the cost of uprooting, clearing, selective shade felling and planting works to about Rs 310 to the acre, the cost of planting on a new clearing of jungle land comes to just over Rs 500 at Balehonnur. The costs are a little over twenty per cent of this figure at Chethalli.

Seed and Seedling supply: Seeds of four strains of arabica and two of robusta were under large scale distribution. 2343 lb. of arabica and 424 lb. of robusta seed from the two Stations were distributed to 777 planters as against a total of 2,254 lb. of seed of both varieties to 699 planters in the earlier year. The demand for seed of Station Selections continued to show an ever- increasing trend and supply had often to be limited to fifty per cent of requirements. A further 3,500 lb. of seed were collected from marked plants in Selection Blocks of registered estates and distributed to 470 planters.

The seed blocks of these selections at the two Stations have been enlarged to meet this increasing demand and new blocks have been opened and planted to them. In addition, 27,600 basket plants and 8,000 bed plants were raised at Balehonnur and 24,500 basket plants and 4,100 bed plants were raised at Chethalli for estate planting and supply to planters.

Miscellaneous crops

Paddy was grown on 1.67 acres at Balehonnur and 6 acres at Chethalli. The following quantities of grain and straw were obtained:

	Grain	*Straw*
Balehonnur	2,200 lb.	6,000 lb.
Chethalli	8,780 lb.	5,760 lb.

The yields were disappointing, in spite of an attempt to adopt the Japanese technique. Disease in the monsoon period and an unseasonal shower during the milk ripe stage upset calculations.

Orange: The crop at Chethalli was most disheartening and was practically negligible after the bumper crop of the previous year. Only Rs 675 were realized during the year on this account. The prospects for the coming year are however bright and a more than average crop is expected.

Pepper: A small quantity of 118 lb. of green pepper was picked at Balehonnur.

Others: Specimen plots of green manure, fibre crops, cotton and tung oil and new shade plants were raised at both the Stations for supply to estates and observational studies.

General Amenities

The two Stations continued to have their own arrangements for water supply. A Generator was in service at Balehonnur for electric power and light. The generator at Chethalli went out of order in the early part of the year on account of long service and wear and tear, and replacement of the Unit was under consideration.

A Canteen was being run at Balehonnur for the labour force.

A crèche for children was started at Chethalli and mid-day meals for non-working children were provided.

A Radio was in working at Balehonnur and sports amenities were provided at both the Stations.

A Projector was acquired during the year and screening of films of technological and rural interest was arranged for labour and other staff and four such expositions were held during the year.

EXTENSION SERVICE

The year saw the extension arm of the Research Department initiated into active service with the posting of the Liaison Officers to the several coffee divisions. As reported in the earlier year, the following six major divisions of coffee were formed with a Junior Liaison Officer in charge of each such division.

	Division	*Headquarters*
1.	Chikmagalur Division	Chikmagalur (Mysore State)
2.	Mudigere Division	Mudigere ,,
3.	Saklespur Division	Saklespur ,,
4.	N. Coorg Division	Somwarpet (Coorg)
5.	Nilgiris-Malabar Wynaad Division	Kalpetta (Madras State)
6.	Shevaroys Division	Yercaud (Madras State)

The Senior Liaison Officer was placed in supervisory charge of the Coorg and Wynaad Divisions and in direct charge of the areas in Nelliampathies, Pulneys, Anamallais, N.E. Nilgiris and Travancore-Cochin State.

The immediate response to their posting was most encouraging in the amount of co-operation and intelligent interest the planting associations, the planting industry and other co-ordinating departments took in enabling these officers to contact the planters in their jurisdictions.

The rising tempo of advisory correspondence demanded from the Directorate and associated technical divisions reflected the feeling that this type of service at an accelerated rate was long overdue.

The collection of essential statistics about the area under crop, its distribution and the type of coffee grown in consultation with various Government Departments, planting associations and the Marketing Department of the Board formed the first step in establishing contacts with planters in all these zones. A survey of the different cultural practices followed in the contacted estates, their classification according to results, variations from normal and a discussion of the reasons for variations were made with a view to draw up advisory programmes for re-orientation of cultural techniques or the rehabilitation for upgrading production. Peculiar zonal problems requiring both fundamental and applied studies were assessed and reported to the Research Department for detailed investigation.

As a corollary to such a survey and the advisory visits, demonstration and exploratory trials were laid out in each of the Divisions to show the usefulness of advised practices for upgrading yield and to regularise and define the type or practice that may be useful to the area.

I toured in all the Liaison Divisions visiting 130 big planters and an equal number of small planters in those areas. Advantage was taken of these visits to contact groups of small planters and discuss with them the usefulness and the practicability of the cultural measures advocated by the Department especially with reference to plant protection, manuring and shade regulation. Impress was also made during these visits of the necessity of replanting and regenerating their plantations and the possibility of so doing to Station Selections with the aid of the Department. This contact with small planters had a happy reciprocal

result. The year saw small planters either in groups or individually come to both the Research Stations. Nearly 600 planters of whom more than 50 per cent were small planters visited the Stations. Over 6,000 advisory letters were issued from the main and sub-stations against a normal of 600 letters two years earlier.

A brief review of the work done in the several liaison divisions is presented in the following paragraphs.

Sri T. V. Pattabhiraman, the Senior Liaison Officer, spent 143 days on tour and visited 156 big estates in the Pulneys, North and South Coorg, Nilgiris, Malabar and Nilgiris Wynaad. Over 200 small growers were contacted either individually or in groups during these visits. 1757 letters were received and answered mainly on advisory work pertaining to problems such as manuring, spraying, shade management and plant protection.

Repeated visits to Pulney Hills where, though a major coffee area, none of the up-to-date operations seem to be existent, resulted in the setting up of demonstrations in two estates on pest control, in seven estates on spraying against leaf disease and in seven estates again on demonstration of complete composite treatments. Where water facilities were limited and spraying was a difficulty, introduction of leaf disease resistant material has also been taken up. It is encouraging to note that there has developed a growing demand in this area for a separate liaison division for themselves and a desire to extend the exploratory and demonstration trials now laid out in large measure.

The problem of green bug infestation in a more or less endemic form in the North East Nilgiris formed a major concern of this Division. A survey of incidence and intensity with special reference to zonal variations has been programmed to be taken up in consultation with the technical officers at headquarters.

Chikmagalur Liaison Division, Chikmagalur

Sri G. I. D'Souza continued to be in charge of this Division. The area is spread over 58 villages of Chikmagalur taluk and 4 villages of Tarikere Taluk in Mysore State and comprises of 31,254 acres owned by 1756 growers. Nearly 80 per cent of these are small growers possessing less than 25 acres.

Four hundred planters were contacted during the year and 301 days were spent on tour establishing these contacts and laying out exploratory and field trials. 313 estates of which more than 60 per cent were small were visited. The visits comprised of study rounds, visits by requests and follow-up visits with special reference to critical examination of cultural, protective and other practices, nature of the plant material and to assess means of re-orientation or re-habilitation.

As part of the demonstration work, 4 blocks were laid down to demonstrate the complete cultural practices advocated by the Department. They were each situated in a small holder's estate representative of the zone. Two of the fundamental manurial trials reported earlier were laid down during the year. 12 exploratory blocks for comparative trials of Station Selections were also located in representative areas.

A survey of the incidence and intensity of pests and diseases in this area was taken up as part of the programmes of studies of essential problems. Exploratory trials conducted by planters themselves with proprietary preparations of pesticides and fungicides were being supervised. As a result of frequent contacts with planters and the setting up of these trials, an acute pest consciousness and an obvious desire to take effective control measure either cultural, biological or chemical was clearly noticeable among most planters.

Mudigere Liaison Division, Mudigere

Sri H. S. Puttaswamy was in charge of this Division throughout the year. This area includes all coffee in the taluks of Mudigere, Koppa and Narasimharajapura of Chikmagalur District and Aldur, Khandya hoblis of Chikmagalur taluk and some outlying coffee in Thirthalli Taluk of Shimoga District in Mysore State.

For purposes of 'approach' techniques, this Division has been divided into 6 ranges—Koppa, Balehonnur, Kalasa, Banakal, Mudigere and Aldur. The total area under coffee is 35,081 acres and owned by 5,064 planters of whom nearly 80 per cent again are small planters owning less than 25 acres. There is an appreciable extent of robusta in this area in contradistinction to the neighbouring Chikmagalur Division.

218 days were spent on tour visiting 319 estates and contacting 350 planters of all grades. These visits were characterised by group meetings of small planters of which over 50 were held. Particular attention was paid in this area for pest control, especially borer elimination.

Five ½-acre spraying, manuring and composite cultural demonstration blocks were laid out during the year in consonance with the common programme of all liaison divisions. Exploratory trials for comparative study of Station Selections were laid out in seven estates. Seed distribution and selective plant consciousness was one of the main items of this division in as much as nearly 50 per cent of the plant material demanded urgent replanting or rehabilitation.

Saklespur Division, Saklespur

Sri W. Raghavendra Rao was in charge of this Division, lying in the Saklespur, Belur and Alur Taluks of Hassan Dt. in Mysore State and comprising mainly of arabica coffee with a noticeable tendency for extension of robusta in the newer blocks. Coffee occupies 20,417 acres spread over 1,266 estates of which again more than 80 per cent is owned by planters possessing less than 25 acres.

232 days were spent on tour contacting 450 planters and visiting 352 estates. The problem was again one of upgrading small holdings by educating owners in economic and approved techniques of cultural practices, especially plant protection and manuring.

The major problem of this area was of the high incidence of white stem borer on the one hand and the devastating type of leaf disease which ran through the coffee in most years. Repeated approaches to planters on the effective means of controlling these two major deployers have resulted in an appreciable number of planters taking to protective measures with the help of the Liaison Officer. A desire to own protective equipment like sprayers by small planters in particular is a happy sign of this 'health' consciousness.

Four demonstration trials were again laid out in representative areas of this Division as in the earlier cases. Three exploratory trials and two field manurial trials were also laid out during the year to define suitable plant materials and to fix manurial schedules for this zone.

North Coorg Division, Somwarpet

Sri K. T. Bhagat was in charge of this Division throughout the year. The area extends over 26,000 acres and is mainly an arabica tract comprised of 1898 estates of which less than 5 per cent is owned by big planters. It is of interest to note that this area comprises of some of the most advanced estates in the coffee industry. The culture consciousness of planters holding even small blocks of one or two acres is so high that the method of approach is not in respect of routine established operations but in re-orientation and regularization of cultural practices. It is observed that most planters here are manure-minded and take particular care in protective operations. Quite a few are conversant with the necessity for replacement of uneconomical and pest-ridden material.

Large blocks of Station Selections are common in an appreciable number of estates.

The major problem in this area therefore became one of prompt solution of local and long-term problems and over 500 letters were exchanged in advisory correspondence. 250 days were spent on tour visiting 225 estates and contacting 300 planters. Group discussions and group visits made a feature of the touring in this area.

A field manurial trial was laid out in the comparatively less advanced area of Sanivarasanthe zone and 4 demonstration plots were laid out in representative areas of Somwarpet, Suntikoppa and Sanivarasanthe zones. Exploratory trials on 5 estates on plant compatibility were in progress. Special trials on the influence of trace elements in controlling physiological deficiencies and large-scale field trials on nematode control especially eelworm were laid in this zone.

Nilgiri-Malabar Wynaad Liaison Division, Kalpetta

Sri S. J. Mathias was in charge of this Division. The Malabar-Wynaad area, once an important arabica growing zone, is now practically cultivated to robusta. Robusta, which was limited to a small acreage for many years, now covers nearly 32,000 acres distributed among 8,799 growers of whom more than 90 per cent are small growers owning less than 25 acres. The Nilgiris-Wynaad zone of this Division covering 6,500 acres still continues to be under arabica owned by 540 planters of whom again only 10 per cent possess more than 25 acres.

The major problem of this area is one of increasing production, the average yield being one of the lowest for the variety of crop now being grown.

From a preliminary survey, it is felt that quite an amount of primary education in seasonal cultural operations has to be undertaken and a planned programme of planting, manuring and protective operations has to be drawn up for this area. With a view to so doing, 1,500 planters were contacted individually and in groups and at four planters' meetings and at festivals and fairs. 280 days were spent on tour visiting 966 estates. Results of such visits were just beginning to be felt at the end of the year. An active trend for organized cultural operations and pest consciousness were definitely noticeable. A group of planters from this zone visited the Research Station for personal observation and discussion.

Field manurial trials on robusta were laid on 4 estates under varying soil climatic conditions in representative coffee areas of this zone. 4 demonstration plots of composite cultural, protective and manuring operations were located on centrally situated holdings of small growers. These were attracting interested attention of neighbouring planters resulting in some of the operations being taken up by them voluntarily during the course of the year.

Shevaroys Liaison Division, Yercaud

Sri B. K. Chandrappa was in charge of this division covering an area in the Shevaroys Hills of 10,284 acres distributed among 1108 estates of which nearly 990 estates are below 5 acres in extent and only 65 estates are above 25 acres.

The area is situated mainly in the North East Monsoon zone and presents peculiar problems not common to the other coffee areas. Arabica is the main type of coffee grown with a small acreage under robusta of recent origin. Coffee is confined to a composite block and affords great scope for intensive work.

The isolation of this area from the rest of the coffee and the large number of small planters indicated special methods of approach and special problems for solution. The incidence of green bug in a more or less endemic form and the continued infestation by White Stem Borer over years, are the major problems seeking immediate attention. Rejuvenation of old estates, shade management

and a re-orientation of cultural practices in relation to the seasonal variations were equally important problems.

197 days were spent on tour contacting 400 planters and visiting 84 estates apart from the group visits to small estates. Group discussions were held at village centres to educate the planter on shade and soil management as there is an over-shading of coffee in this area.

Four demonstration plots were laid down in representative zones on small growers' estates. A field manurial trial was also laid out.

A study of the problem of curling and browning of leaf was taken up in co-operation with the technical divisions at the main Research Station. Observational studies on plant compatibility with special reference to the 10 Station Selections now under issue and growing in the Shevaroys was taken up to define the variety suited to the zone.

Acknowledgment

It is my privilege and pleasant duty to express a deep sense of gratitude of myself and all members of the Research Department to the many planters who have so generously co-operated in the lay-out of field trials and given unstinted help in so generous a measure. I would in particular extend our grateful thanks to Sri S. N. Ramanna, Mr R. Radcliffe, Mr F. G. Foster, Mr F. Baertschi, Sri C. R. Nirvanappa Shetty, Sri U. K. Laxman Gowda, Sri T. B. Malle Gowda, Sri K. A. Aiyappa, Capt. Channabasappa, Col. W. A. Rahm and Mr C. Primrose.

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It is with gratification and pleasure I record the very happy associations with many technologial associations and institutions and the Departments of Agriculture in Mysore, Coorg and Madras, and their technical, technological and demonstrative divisions in particular.

It is with gratitude that I and my colleagues record the kindness and consideration we have received from the Chairman and the members of the various committees and the Coffee Board.

To the members of the Research Committee, I am deeply indebted. Their support and consideration has encouraged my work.

To the planting community who have willingly placed at the disposal of the Department their knowledge and enthused us in the solution of their many problems and for their traditional generosity, hospitality and consideration to myself and every individual member of the staff alike, I extend my deep sense of appreciation and gratitude.

To the various grades of technical, executive and ministerial services at the two Research Stations and the Liaison Divisions, I cannot be sufficiently grateful. They have borne cheerfully the brunt of the burden by their unstinted hard work and ever-willing co-operation.

A brief review of the work done in the different technological sections together with the sectional reports is given in the following pages.

B. T. Narayanan
Director of Research

APPENDIX I

Meteorological data of the Coffee Research Station, Balehonnur—1954-55

		July '54	*Aug.* '54	*Sept.* '54	*Oct.* '54	*Nov.* '54	*Dec.* '54	*Jan.* '55	*Feb.* '55	*Mar.* 55	*Apr.* '55	*May* '55	*June* '55
1.	Highest Maximum Temperature ...	74.5	79.5	79.9	84.0	83.0	83.0	84.1	89.9	91.5	92.0	89.5	81.2
2.	Lowest Maximum Temperature ...	69.5	62.5	70.5	71.0	77.0	73.0	78.5	80.1	82.5	82.0	79.2	67.0
3.	Highest Minimum Temperature ...	66.5	66.5	65.5	67.0	63.0	65.0	64.8	68.6	68.8	68.4	69.5	67.5
4.	Lowest Minimum Temperature ...	61.5	61.5	62.5	59.0	53.0	54.0	56.4	60.4	59.6	62.5	61.0	61.4
5.	Average Maximum Temperature ...	71.9	72.8	74.9	78.3	79.0	79.6	81.3	86.7	87.4	87.6	83.4	77.3
6.	Average minimum temperature ...	64.7	65.0	64.5	62.0	57.5	59.2	60.0	63.3	64.3	66.0	66.4	66.0
7.	Highest percentage of humidity ...	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%
8.	Lowest percentage of humidity ...	88%	90%	82%	73%	67%	54%	74%	44%	62%	71%	79%	85%
9.	Average percentage of humidity ...	95%	96%	92%	93%	83%	88%	84%	84%	89%	89%	89%	95%
10.	Highest hours of bright sunshine ...	3.36	10.24	8.54	10.30	10.18	10.36	9.54	10.36	10.36	11.18	11.06	7.24
11.	Lowest hours of bright sunshine ...	0.00	0.00	0.00	0.00	7.18	1.12	5.54	6.48	5.48	3.06	0.00	0.00
12.	Average hours of bright sunshine ...	0.24	2.11	3.80	5.50	9.12	7.50	9.06	9.10	8.55	8.07	6.22	2.04
13.	No. of days on which rainfall was below 10 cents	...	1	6	5	...	1	...	...	4	4	3	2
14.	No. of days on which rainfall was between 10-50 cents ...	12	6	12	7	...	2	...	1	2	4	5	10
15.	No. of days on which rainfall was between 50-100 cents ...	7	10	5	6	...	...	...	...	...	...	1	5
16.	No. of days on which rainfall was between 1"-2" ...	6	3	1	...	...	...	...	...	1	2	2	5
17.	No. of days on which rainfall was above 2" ...	6	4	—	...	...	...	...	...	...	...	2	3
18.	Total rainfall for the month ...	43.09	27.90	7.69	6.41	...	0.77	...	0.28	1.80	3.54	19.18	20.16
19.	Total number of rainy days during the month	31	23	18	13	...	2	...	1	3	6	10	25
20.	Highest rainfall during the month ...	5.16	6.63	1.14	0.98	...	0.48	...	0.28	1.53	1.53	8.60	3.10

APPENDIX II

Rainfall data at the Coffee Research Station, Balehonnur—1954-55

(Recorded in inches)

MONTH			1944-45	45-46	46-47	47-48	48-49	49-50	50-51	51-52	52-53	53-54	Average for 10 years	54-55
July	1954	...	41.61	37.52	35.80	35.97	30.93	24.60	58.25	29.31	27.72	54.99	37.67	43.09
August	1954	...	10.09	10.72	37.93	30.34	39.49	25.52	20.11	19.40	28.28	30.70	25.26	27.90
September	1954	...	2.92	9.11	11.51	9.80	6.43	14.80	21.12	9.77	3.72	6.07	9.53	7.69
October	1954	...	12.42	4.25	3.56	2.62	6.80	7.99	6.43	6.74	13.07	20.22	8.41	6.41
November	1954	...	2.71	1.08	7.04	0.14	8.59	1.43	1.27	3.12	0.00	0.00	2.64	0.00
December	1954	...	0.07	0.00	1.09	0.91	0.08	0.00	0.00	0.00	1.42	0.00	0.36	0.77
January	1955	...	0.00	0.00	0.36	0.26	0.00	0.02	0.00	0.14	0.00	0.00	0.08	0.00
February	1955	...	0.00	0.03	0.00	0.00	0.00	0.74	0.00	1.50	0.00	0.00	0.23	0.28
March	1955	...	0.00	0.52	1.86	0.19	0.44	0.00	0.53	0.00	0.00	2.29	0.58	1.80
April	1955	...	3.92	9.05	1.56	0.94	2.16	0.79	3.84	6.29	2.40	9.18	4.91	3.54
May	1955	...	2.73	4.28	5.21	2.41	6.61	3.77	8.43	2.55	0.49	4.40	4.09	19.18
June	1955	...	8.65	23.53	9.90	15.67	10.50	11.57	17.38	13.53	15.36	8.56	14.47	20.16
		Total	85.12	100.09	115.82	109.25	112.03	91.23	137.36	92.35	92.46	146.41	108.23	130.8

APPENDIX III

Rainfall Data at the Coffee Research Sub-Station, Chethalli (Coorg)
(Recorded in inches)

Month	1953–54	Average for previous 15 years	1954–55
July	32.59	23.43	25.66
August	15.35	11.75	12.13
September	1.77	6.09	4.08
October	13.91	7.08	7.68
November	0.00	3.34	0.00
December	0.00	0.49	1.39
January	0.00	0.12	0.00
February	0.58	0.26	0.00
March	1.22	0.84	0.46
April	4.62	4.05	5.61
May	5.99	5.00	11.69
June	11.71	11.00	13.04
Total	87.74	73.45	81.74

PART II

TECHNOLOGICAL SECTIONS

AGRONOMY

Experiments started earlier on different agronomical practices like digging, pruning, weeding and manuring with special reference to the various practices were continued to find out their influence on the yield of coffee. Ecological conditions of aspect, depth of soil fertility and condition of shade were also studied. Indications for the year are that balanced manuring in the post-monsoon period with pruning in February, slash weeding in July, deep digging in August and soil stirring in October-November gave higher yield than other practices either singly or in combination agreeing with the results obtained last year.

Trials on the effect of pruning and manuring at two levels of nitrogen (40 and 80 lb. to the acre) with a constant dose of 30 lb. P_2O_5 and 40 lb. K_2O given in two doses once pre- and once post-monsoon on robusta coffee were continued at two private estates and at the Research Station. It was again observed that increased production of crop was obtained at the lower levels of nitrogen though in one case 80 lb. of nitrogen gave a numerically higher yield. Pruning with manuring at 40 lb. nitrogen appeared to increase yields.

A trial on the influence of renovation pitting, trenching and contour drainage, weeding and deep and light digging at different seasons was started early in June 1954 to study the effects of these practices on crop production. Indications were that soil stirring at three different seasons with effective drainage improved the appearance of bush and health of the plants. No results were available of any increase in production. The study is in progress.

A similar experiment was conducted at the Research Sub-Station, Chethalli (Coorg).

An exploratory trial to study the effect of deep and light digging during three seasons of the year—early summer, mid monsoon and late autumn early winter—was started during the year. This was particularly intended to verify the *raison d'etre* of the wide variation in the established soil cultivation practices of the different coffee zones.

Observations on the setting of berry in relation to the number of flowers opened started early in 1953-54 were continued. Counts were started in April 1954 and completed with the ripening of fruits on October 1954. A wide selection of fruiting branches was marked for this purpose. The influence of the retention of leaf on this relationship was also studied. It was found that the retention of berries and carrying them to ripening stage was more in the case of branches having all leaves than the branches with less leaves, which is in accordance with physiological conditions. This confirms our earlier findings.

The study on mean berry retention was extended to six Station Selections early in the crop season 1953-54. It was then found that retention did not exceed 35 per cent of blossom, surprisingly contrary to general field observations in the earlier years where nearly 50 per cent was estimated to have been retained. Whether this recession was due to the heavy leaf fall mentioned earlier is being examined. The study is continued.

A trial was started in December 1954 to find out the viability of germination of arabica coffee with parchment cover (*i*) intact (*ii*) split or (*iii*) removed—

treated with ash or not and stored in air-tight tins or gunny bags. The indications are that seeds with parchment cover entirely removed, whether ashed or otherwise, gave germination 8 to 10 days earlier than germination in the case of seeds whose parchment cover was split or was intact.

BOTANY

Work on coffee breeding with reference to leaf disease resistance and high yielding even bearing qualities was continued. Production of seeds from selections, vegetative propagation of good bearers, comparative trials of clonal plants from the above and collection of plant material of known parentage and quality, both local and foreign, formed the principal work of this Division. Detailed fundamental cytological studies on arabica and robusta selections formed a major portion of the work in the laboratory in order to define the type and characteristics of the Station Selections.

Seed preparation, collection and distribution from established strains possessing leaf disease resistance and of high and even bearing qualities were continued. Four strains of arabica and two of robusta were under large-scale distribution. 2,343 lb. seed of arabica and 424 lb. seed of robusta selections from the two Stations were distributed to 777 planters against 1891 lb. of arabica and 363 lb. seed of robusta selections supplied to 699 planters during 1953-54. It is expected that over 3,000 lb. seed from the two Stations and a larger quantity from blocks of established selections in private estates would become available for supplies in the coming year.

In modification of the original programme of raising seedlings and distributing them to planters, seed plots were selected in estates to which selections had been issued in earlier years. 19 estates were selected and plants in the blocks from which seeds were to be collected were marked and kept under strict observation. 3,078 lb. seed of arabica selections and 453 lb. seed of robusta were collected and distributed to 470 planters from these seed blocks.

Further work on selfing of the 4th generation of two of the pure line cultures of arabica, the second generation of six arabica cultures as well as of F_2 and F_3 of two selections cross-bred with commercial strains—Coorg and Kent—was undertaken to raise further generations in order to develop quality and out-turn. These were extended to the field where nine inter-crosses of arabica cultures selected for high yield were under observation, for vigour, productivity and leaf disease resistance. Ten further crosses were effected.

Work on inter-specific crosses between arabica, robusta, liberica and excelsa was continued.

It was observed that plants from 4th generation progeny from a selected plant from S.288 and a 3rd generation progeny from a selected plant from S.288 cross-bred with Kents have shown no segregation of susceptible plants whatsoever, indicating the possibility of having arrived at a type.

The year was high-lighted by a demonstration in grafting arabica scions to robusta parent stock or selected arabica stock as an effective and economic means of improving inefficient or unprofitable plant material. This was attended by 27 planters from coffee growing areas in Mysore, Malabar-Wynaad and Travancore-Cochin. Planters were themselves allowed to actually take part in the grafting operations.

The Station continued to be a centre for seed and plant exchange with other coffee growing areas in the world and formed one of the main centres for co-operation on coffee germ-plasm collection. The Station Selections especially S.288, S.333 and S.795 were in great demand. Seeds of three arabica selections were supplied to Ceylon, Thailand, Philippines, U.S.A., France, Nyasaland, Liberia, Kenya and Lyamungu. Seed of 43 arabica varieties and 12 coffee species were received from these countries and from Indonesia, Portugal and Angola.

Field trials were laid with 33 varieties of arabica and Kawisari coffee. Seeds of these had been received in the previous year from Malaya, Indonesia, France, Portugal, U.S.A., Guatemala, Belgian Congo, Ethiopia, Kenya and Lyamungu. Under the conditions at the Station, all the arabica varieties appear to be showing susceptibility to leaf disease.

Experiments for comparing the performance of both arabica and robusta coffee on Multiple or Single Stems seem to show definite indications that there is no appreciable increase in yield from the Multiple Stem. On the other hand, the incidence of White Stem Borer on Multiple Stem of arabica and the shothole borer on the Multiple Stem of robusta appears to be very high. It would therefore be that the growing of coffee on Single Stem—the common practice now obtaining in India—is perhaps the best so far as this country is concerned.

CHEMISTRY

Experiments on the manurial requirements of coffee, land management with special reference to soil and moisture conservation, influence of trace elements on yield and health factors, the use of spray technique for optimum requirement of food at stipulated times and the quick processing of fruit into parchment by accelerating fermentation after pulping, formed the main items of work of the Chemical Division. The section was also employed on the routine examination of soils and manures for advisory work. The survey of soil types in relation to micro-climatic conditions was also continued.

The fundamental manurial trials were extended to a study of the application of varying doses of nitrogen from 40 to 100 lb. at rising levels of 20 lb. to the acre with a basic dose of 30 lb. of phosphoric acid (P_2O_5) and 40 lb. of Potash (K_2O). Trials on the use of different forms of nitrogen and on the application of varying doses of phosphate and potash with a basic high level of nitrogen were also undertaken to enable to draw a co-ordinated conclusion on the needs of fertilizers. While no conclusive results have been obtained, indications from the earlier trials are that coffee in these areas responds to an application of a complete fertilizer mixture and to nitrogen, and nitrogen and phosphate where natural fertility is well-established. Physiological observations, however, stress the need for a complete mixture both for setting of fruit and its development.

Field trials were undertaken on the application of levels of nitrogen varying from 40 to 100 lb. to the acre with or without a basal application of 30 lb. of phosphate and 40 lb. of potash on 11 private estates in different coffee zones. These trials were primarily intended to examine the varied and various views of the requirements of fertilizers in the different zones and in the ultimate to draw a co-ordinated plan for fertilizer treatments in each particular zone. Similar trials on robusta were started on 10 different estates in the major robusta growing areas. These trials are being modified and extended in the coming year to study the known differential requirement of robusta for the major plant foods and their relationship to the setting of blossom and their influence on crop yields.

Nursery and field trials were undertaken to test the influence of trace elements on the quality and well-being of the plant. Both soil application and application by spray were employed. A field trial on the influence of spraying fertilizer solutions for physiological and yield influences was started. Encouraging signs had to be had that apart from soil application, such spray at stipulated times definitely improved the health of the plant and helped in maintaining the crop on the tree. Further trials are in progress.

Studies on the evolving of a technique for the acceleration of pectic digestion and fermentation in the processing of fruit to parchment gave interesting results. Several proprietary preparations, and of common acids and alkalis like sulphuric

and hydrochloric acids and caustic soda and potash and sodium carbonate at varying concentrations were tried. Indications were that both acids and alkalies accelerated digestion and the removal of mucilagenous adherence completed in much shorter time than either pectinases or the proprietary mixtures. It was found that a 10 per cent solution of caustic soda at 1 to 1.5 per cent by weight of raw wet parchment to be treated completed the reaction in 15 to 20 minutes and it was possible to complete clean washing of the coffee in less than one hour thereafter. This compares very favourable against the normal 24 to 36 hours usually required for natural fermentation and washing. Demonstrations at representative estates in Coorg and Mysore were conducted. Advisory circulars were issued to 30 other estates during the course of the year.

Physiological studies on the absorption of nutrients by the plant were in progress. The results so far obtained confirm the earlier work of the continued need for nitrogen and the periodical need for potash and phosphorus at maximum levels. An optimum level of calcium in the soil as a mobilizer of other nutrients and the maintenance of the carbohydrate balance was also noticed.

PLANT PROTECTION

Entomology

During the year 1954-55, investigations were continued with the use of pesticides in the control of coffee stem borer, shot-hole borer, green bug (the major pests of coffee) and eelworm. New experiments were laid out for the control of shot-hole borer, green bug and eelworms. Studies on the incidence of parasites and predators on common pests of coffee; residual toxicity of insecticides; effect of B.H.C. on flavour of coffee; use of systemic insecticides in the control of coffee stem borer; survey on the incidence of pests on coffee were undertaken.

Studies on the control of White Stem Borer of coffee by the use of chlorinated hydro-carbons, systemic and other organic insecticides again showed that B.H.C. formulations as a stem wash were definitely effective in controlling the pest. In view however of the apprehension that continued application of B.H.C. may develop a taint in coffee, other pesticides were also under trial. Indications are that Dieldrin and its formulations may be equally effective controlling agent and that Dieldrin has perhaps a longer effective toxicity than any other formulations so far used. Confirmatory trials are in progress. Cup-testing of B.H.C. treated coffee is also being undertaken to verify the presence or absence of any taint in flavour.

Studies on the biological control of green bug by the two entomogenous fungi—*Cephalosporium lecani* and *Empusa lecani* were continued during the year. Attempts on the preparation and broadcasting of these cultures at the optimum infestation period were not successful. Other techniques of preparing and preserving the culture are under study.

Trials with proprietary preparations like Ekatox and H.E.T.P. confirmed our earlier findings of their effectiveness for controlling green bug, provided they are correctly timed on pest infestation anticipated.

Comparative trials with organic and systemic insecticides on the one hand and cultural techniques like pruning, manuring and regulation of shade on the other are in progress to evolve control measures for shot-hole borer. In certain preliminary field trials, considerable reduction in infestation was noticed by these cultural operations. Confirmatory trials are in progress.

Incidentally studies were undertaken to find out the effect against the ambrosia fungus (upon which shot-hole borer develops) of the use of Bordeaux by itself or in combination with the pesticides and thus evolve a technique for direct control.

Field and laboratory studies on the control of eelworm in coffee soils were continued. Comparative trials with soil pesticides, sterilizers and fumigants

like Ekatox, Hanane, B.F.P.O., Sytam, Folidol E. 605 (organo phosphorus compounds), Cynogas, Shell D.D., Lime, Calcium cyanamide, Sulphur and Urea were undertaken, and the results so far obtained indicate that Ekatox was effective in arresting the increase of eelworms provided constant periodic applications were made. Soil amendments with calcium cyanamide, sulphur and urea decreased the population of eelworms and was found to be better than other treatments. In view of these indications, an experiment on a revised plan has been started to test the comparative efficiency of calcium cyanamide and urea with or without the addition of sulphur.

An exploratory survey of insect incidence with reference to seasonal variation and intensity, ecological conditions of the common insect pests of coffee was started.

Laboratory studies on the possible parasites and predators on common pests of coffee were undertaken in co-operation with the Liaison Department as an extension of the survey of incidence and periodicity of such pests in the several coffee zones.

Mycology

Field trials on spraying of coffee to find out efficient methods of control and to evaluate the efficiency of various fungicides (copper, mercury and other organic fungicides) as compared with the standard Bordeaux mixture spray in controlling leaf disease and fundamental work on the life history and possibilities of control of the common diseases of coffee bush formed the main work of this Division.

Repeated trials with proprietary, organic and systemic fungicides still continue to show that spraying with Bordeaux at stipulated intervals at least twice a year and if necessary thereafter with every flush of leaf is the most effective method of controlling leaf disease (*Hemileia vastatrix*).

Studies on the use of fungicides for controlling blackrot and die-back showed that spraying at stipulated intervals with Bordeaux gave maximum control.

Studies on the physiological specialisation of *Hemileia vastatrix* were revived and inoculation experiments for the isolation and further study of the four known strains of *Hemileia* were started.

Laboratory studies on the isolation of causative organisms from diseased material were made in the following cases:

1. Damping off and collar rot of coffee seedlings in the field and the nursery.
2. Wilting and death of young plants in the field.
3. Stump rot and brown rot of coffee.

Experiments to evolve a suitable seed dressing technique to improve germination percentage of seed material or to induce an appreciable reduction in pre-emergence damping off showed that there is no significant improvement in either by such seed treatment.

It is found that post-emergence collar rot can be successfully controlled if proper sanitation methods are observed in the field. Under serious incidence, weekly spray of Bordeaux to drench the soil in the nursery beds was found to effectively check further spread.

B. T. Narayanan
Director of Research

I. AGRONOMY

Field Experiments

Experiments on different cultural pactices with special reference to season, micro-climatic and soil conditions and their relation-ship to cost of operations formed a major portion of the work of the Agronomy Division. Technological studies on berry-blossom ratio in relation to the influence of leaf retention on this factor formed an important phase of the work. Exploratory trials on soil moisture conservation techniques in co-operation with the division of Chemistry were also undertaken.

The following experiments were conducted during the year:

I. Trials in Agronomy practices, Coffee Research Station, Balehonnur.

II. Studies on the influence of varying practices of soil cultivation on yield of arabica coffee.

(*a*) Soil Cultivation Experiment, Coffee Research Station, Balehonnur.
(*b*) Soil Management Experiment, Coffee Research Station, Balehonnur.

III. Manurial Experiment on robusta—influence of varying levels of nitrogen with fixed application of P and K on yield of coffee—Coffee Research Station, Balehonnur (Mysore State).

IV. Robusta Manurial and Pruning Experiments (Private Estates):

(*a*) Experiment at Bhadra Estate, Balehonnur, Mysore State.
(*b*) Experiment at Devadhanam Estate, Balehonnur, (Mysore State).

V. Experiment on the influence of topping on growth of Robusta Coffee (Byregudda Estate, Balehonnur, Mysore State).

VI. Observational studies on Blossom Berry Correlations, Coffee Research Station, Balehonnur, (Mysore State).

VII. Studies on the germination in arabica coffee seeds, Coffee Research Station, Balehonnur (Mysore State).

I. Trials in Agronomy Practices

This experiment laid out in the Coffee Research Station, Balehonnur, in 1951, was continued. In this experiment different cultural practices that are in vogue in coffee estates are tried individually and in combinations. The experiment is carried out to see whether an optimum combination of these agronomical practices could be arrived at to give maximum benefit to the plant resulting in increased yields under varying ecological conditions of shade, depth of soil and fertility.

Locality: Balehonnur. *Lay-out:* Randomized. *Replications:* 4. *Year:* 1954-55. *Variety:* Coorg. *Treatments:* 14.

Plot Size

I, II and III Replications:	Gross	— 18 × 8 = 144	plants or 8.3	cents
	: Nett	— 13 × 6 = 78	,, or 4.48	,,
IV Replication	: Gross	— 15 × 8 = 120	,, or 6.88	,,
	: Nett	— 13 × 6 = 78	,, or 4.48	,,

Total area under the experiment: 4.45 acres.

Yield Data of Trials in Agronomy Practices

Symbol.	Treatment	1951–52 Acre yield		1952–53 Acre yield		1953–54 Acre yield		1954–55 Acre yield	
		Ripe Cherry lbs.	Clean Coffee cwt.	Ripe Cherry lbs.	Clean Coffee cwt.	Ripe Cherry lbs.	Clean Coffee cwt.	Ripe Cherry lbs.	Clean Coffee cwt
A	Details given in the next page	1774	2.72	649	0.88	4349	6.81	4783	7.94
B		2346	3.60	570	0.84	3574	5.86	5463	8.69
C		2128	3.27	486	0.76	4659	8.06	5733	9.48
D		1892	2.90	493	0.68	4699	7.57	4891	8.42
E		2082	3.20	510	0.76	4086	7.29	4487	7.44
F		1833	2.81	384	0.53	3724	6.66	5910	9.55
G		2323	3.57	358	0.55	4351	7.77	5172	8.39
H		2017	3.10	486	0.67	3791	6.51	5130	8.73
I		2300	3.53	460	0.69	4065	6.80	5529	9.25
J		2054	3.17	367	0.46	4386	7.33	6972	7.48
K		2092	3.21	298	0.49	3885	6.71	4802	7.91
L		1833	2.81	398	0.56	3403	6.08	4766	7.24
M		2200	3,38	500	0.60	4193	6.06	4709	7.86
N		2205	3.39	341	0.49	3790	6.47	5361	8.97
General Mean:		2077.78	3.19	450	0.64	4068.2	6.86	5957.7	8.37
Significant or not			No	Yes		No		Yes	
Critical Diff.			1.18	122. 4		158. 2		508.25	
S.E. per cent Mean			12.83	13.31		1.91		16.72	

Treatment J, wherein pruning in February, slash weeding in July, deep digging in August, manuring in post-monsoon and soil stirring in October-November are conducted, has given numerically highest yield of crop. The experiment is continued while it is interesting to observe that during all these three years, varying results have been obtained with reference to the cultural practices that were superimposed; the influence of an application of a composite mixture of fertilizers has been common to all the significant treatments. Further work is in progress.

II. Studies on the influence of varying practices of soil cultivation on yield of arabica coffee

(a) *Soil Cultivation Experiment, Coffee Research Station, Balehonnur*

This experiment was started in June 1954 with a view to compare different methods of cultivating the soil in the several seasons and to find out a way in which the soil in the old coffee could be profitably cultivated aiding in improved yields and also in conserving, to an appreciable extent, the soil: moisture status.

Following are the details of the experiment:

Locality:	Balehonnur	*Started:*	June 1954
Lay-out:	Randomized	*Variety:*	Coorgs
Replications:	4	*Age:*	About 30 years
Treatments:	6	*Terrain:*	Slopy
Plot size:	4 × 20 = 80 plants 4.5 cents	*Spacing:*	5′ × 5′

Total area under the experiment: 1.08 acres.

Details of Treatments of Trials in Agronomy Practices

No.	Symbol	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.	A	...	...	...	...	...	...	SW	DD	M Post-monsoon	SS		...
2.	B	...	M Pre-blossom		...	...	...	SW	DD	...	SS		...
3.	C	...	...	...	M Post-blossom		...	SW	DD	...	SS		...
4.	D	...	...	...	...	...	...	SW	...	M		...	...
5.	E	...	...	...	M		...	SW	...	KDAGM		...	...
6.	F	...	...	...	...	...	...	CW	...	M		...	CW
7.	G	...	...	...	M Pre-monsoon		...	CW	...	CW		...	CW
8.	H	...	SSM		...	...		CW	...	...	...	...	...
9.	I	...	...	...	M (20-30-40) Pre-monsoon		...	SW	...	M 20 N only KDAG		...	...
10.	J	...	PR		...	...	...	SW	DD	M	SS		...
11.	K	...	PR		...	...	...	SW	...	M KDAG		...	...
12.	L	...	M		...	...	...	...	...	...	...	...	D(MF) ML
13.	M	...	30M Am. Sulphate		...	...	...	...	...	30M Am. Sulphate		...	...
14.	N	...	30M Sodium Nitrate		...	...	...	...	...	30M Sodium Nitrate		...	...

Remarks

Manuring:

Unless otherwise stated: M. manuring at 40-30-40 with Urea; Rockphosphate and muriate of potash for N, P_2O_5 and K_2O respectively.

SS: Soil stirring SW: Slash weeding CW: Clean weeding DD; Deep digging D(MF): Digging with mamooty fork ML: Mulching PR: Pruning

KDAG: Kadagathe

Treatments

Symbol		*Details*
A	=	Trenching—$1\frac{1}{2}' \times \frac{3}{4}' \times 5'$ long—July
B	=	Trenching—$\frac{3}{4}' \times \frac{3}{4}' \times 5'$ long—July
C	=	Renovation pitting:—$1\frac{1}{2}' \times \frac{3}{4}' \times 3'$long—July
D	=	Deep digging—November
E	=	Light digging—November
F	=	Control—weeding only

The experiment is in progress.

(b) *Soil Management Experiment*

This experiment was extended in July 1954 to study the influence on old coffee of different types of soil management of various grades during different seasons and observing their reaction as reflected by the yeild.

Locality :	Balehonnur	*Year:*	1954-55
Lay-out:	Randomized	*Variety:*	Coorgs
Replications:	4	*Age:*	30-40 years
Treatments:	7	*Spacing:*	5′×5′
Plot size:	5 × 16 = 80 plants = 5.4 cents		

Total area under the experiment: 1.26 acres.

Following are the details of the treatments:

Symbol	*Treatments*
A	Deep digging in August
B	Light digging in August
C	Deep digging in November
D	Light digging in November
E	Deep digging in April
F	Scuffling in April
G	Control—only weeding.

The experiment is in progress.

III. **Manurial Experiment on robusta—influence of varying levels of nitrogen with fixed application P and K on yield of coffee, Coffee Research Station, Balehonnur (Mysore State)**

This experiment started at the Coffee Research Station, Balehonnur in 1951 was continued.

This experiment envisages the effect of applying the complete manure to robusta with two varying nitrogen levels of 40 lb. and 80 lb. per acre. Nitrogen is applied in two split doses—once during pre-blossom and again during post-monsoon. Thirty lb. of phosphoric acid and 40 lb. of potash, kept constant, were applied during post-monsoon. Half the number of plots were given light pruning during pre-blossom.

Locality:	Balehonnur	*Year:*	1954-55
Lay-out:	Randomized	*Variety:*	Robusta
Replications:	6	*Plot size:*	Gross: 4 × 8 = 32 plants = 4.7 cents
Treatments:	3		
Total area under the experiment: 0.85 acres.		*Nett:*	2 × 6 = 12 plants = 1.8 cents

Yield data of Robusta Manurial Experiment

Sl. No.	Symbol.	Treatment	1951–52 Acre yield		1952–53 Acre yield		1953–54 Acre yield		1954–55 Acre yield	
			Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee	Ripe Cherry	Clean Coffee
			lbs.	cwt.	lbs.	cwt.	lbs.	cwt.	lbs.	cwt.
1	A	Manured @NPK= 40-30-40	1739	3.02	2427	5.07	3231	6.04	2494	3.95
2	B	Manured @NPK 80-30-40	1804	3.27	2172	4.25	2710	5.87	2338	3.70
3	C	Control No manure	1331	2.44	2333	4.51	3231	5.38	2254	3.70
		General Mean	1624.7	2.91	2310.7	4.61	3057.3	5.76	2362	3.78
		Significant or not		No	Yes		Yes		Yes	
		Critical difference		1.70	221		1189.5		254.2	
		S.E.M.%		10.27	4.293		24.22		28.98	

Treatment receiving 40 lb. nitrogen, 30 lb. phosphoric acid and 40 lb. potash gave the maximum yield. It is interesting to observe this trend throughout the range of this experiment and the indications are that in the case of Robusta, the ratio seems to be weighted in favour of P and K with reference to N experiment is in progress.

IV. Robusta manurial and pruning experiments (Private Estate)

(a) *Experiment at Bhadra Estate, Balehonnur, Mysore State*

Concurrently, experiments on the lines indicated above were laid out on private estates. These experiments were extended to study the influence of handling and light pruning on yield of coffee with or without application of a complete mixture of two levels of nitrogen and fixed levels of phosphate and potash. The experiments are laid out on latin square method.

Two levels of nitrogen at 40 and 80 lb. to the acre with a fixed level of 30 lb. of phosphate and 40 lb. of potash are given wherever manures are applied.

Application of half the dose of nitrogen is done during pre-blossom and the rest, along with phosphoric acid and potash, is done during post-monsoon. In treatments to be pruned, pruning is given pre-blossom.

Locality: Bhadra Estate *Treatments:* 6 *Year:* 1954-55
Lay-out: Latin square *Variety:* Robusta
Replications: 6 *Plot size:*
Total area under the experiment: 3.17 acres
Gross: 6×10=60 plants = 8.8 cent
Nett: 4×8 = 32 „ = 4.7 „

Yield data of Robusta Manurial and Pruning Experiment (Bhadra Estate)

Sl. No.	Symbol.	Treatment	1952–53 Acre yield Ripe Cherry	1952–53 Acre yield Clean Coffee	1953–54 Acre yield Ripe Cherry	1953–54 Acre yield Clean Coffee	1954–55 Acre yield Ripe Cherry	1954–55 Acre yield Clean Coffee
			lbs.	cwt.	lbs.	cwt.	lbs.	cwt.
1	A	Control—no manure	3836	6.80	3417	5.50	4178	7.08
2	B	Pruned only, no manure	3586	6.31	3346	5.29	3889	7.31
3	C	Manured @N P K 40-30-40	3707	6.48	3705	5.95	3687	6.91
4	D	,, 80-30-40	4038	7.10	3623	5.38	4133	7.75
5	E	N P K@ 40-30-40+Prune	4265	7.49	3664	5.60	5046	10.36
6	F	N P K@ 80-30-40+Prune	3925	6.79	3665	6.18	4164	7.81
		General Mean	3892.5	6.81	3553.3	5.65	4182.8	7.87
		Significant or not	Yes		Yes		Yes	
		Critical difference	624.7		267.8		378.3	
		S.E.M. per cent	9.67		3.584		26.01	

The results confirm earlier findings that application of manures at 40N, 30P and 40K with light handling of bushes gives consistently higher yields than the other treatments.

(b) *Robusta Manuring and Pruning Experiment at Devadhanam Estate, Balehonnur, Mysore State*

This experiment, carried out at Devadhanam Estate, Balehonnur from 1952, is continued and is identical with the one carried out at Bhadra Estate, Balehonnur, reported earlier.

Localy: Devadhanam Estate *Year:* 1954-55
Lay-out: Latin Square *Variety:* Robusta
Replications: 6 *Treatments:* 6
Plot size: *Gross:* 6×10=60 plants=8.8 cents
Nett: 4×8=32 ,, =4.7 cents

Total area under the experiment: 3.17 acres.

Yield data of Robusta Manurial and Pruning Experiment at Devadhanam Estate, Balehonnur

Sl. No.	Symbol.	Treatment	1952–53 Acre yield Ripe Cherry	1952–53 Acre yield Clean Coffee	1953–54 Acre yield Ripe Cherry	1953–54 Acre yield Clean Coffee	1954–55 Acre yield Ripe Cherry	1954–55 Acre yield Clean Coffee
			lbs.	cwt.	lbs.	cwt.	lbs.	cwt.
1	A	Control—no manure	5428	9.27	3097	4.29	3682	6.23
2	B	Pruned—no manure	5983	8.93	2812	4.52	4393	8.24
3	C	Manured N P K @ 40-30-40	5817	8.50	3472	5.57	3781	7.09
4	D	Manured N P K @ 80-30-40	5688	9.82	3466	5.16	4543	8.52
5	E	Manured N P K @ 40-30-40 + prune	6545	11.52	3167	5.16	4156	8.53
6	F	Manured N P K @ 80-30-40 + prune	6040	10.79	3371	6.28	4699	8.81
		General Mean	5916.9	10.31	3230.8	5.16	4209	7.90
		Significant or not	Yes		Yes		Yes	
		Critical difference	374.5		298.5		350.3	
		S.E.M. per cent	3.03		4.44		23.94	

It is again seen that Treatment E continues to give significantly higher yields though this year Treatment F gives a non-significant numerical higher yield.

V. Experiment on the influence of topping on growth of Robusta Coffee (Byregudda Estate, Balehonnur, Mysore State)

This experiment laid out at the Byregudda Estate, Balehonnur, in 1951, was continued.

Locality: Byregudda Estate *Year:* 1954-55
Lay-out: ABBA *Variety:* Robusta
Replications: 12 *Plot size:* 8×4=32 plants=5.95 cents
Total area under the experiment: 1.43 acres.

Result of Robusta Topping Experiment, Byregudda Estate

Sl. No.	Symbol.	Treatment	Average increase in length of branch 1952–53	1953–54	1954–55
1	A	Topped at 3 ft. level	1.27 cm	0.5258 cm	0.1973 cm
2	B	Topped at 4 ft. level	1.18 cm	0.4168 cm	0.1900 cm
		General Mean	1.28 cm	0.4713 cm	0.1936 cm
		Significant or not	No	Yes	No
		Standard Error per cent Mean		9.198	0.0077

No significant result is obtained during the year. However, the plants topped at 3 feet level continued to make better growth than those topped at 4 ft. level.

VI. Observational studies on Blossom Berry Correlations (Coffee Research Station, Balehonnur, Mysore State)

(1) A set of blossom berry observations, started in April 1954, was continued during the year and completed in October with the ripening of the fruits.

Twelve Kent Arabica plants were selected from which two types of branches were tagged.

They are :

A—branches with *all* leaves present.

B—branches with *less* leaves in the same number of nodes.

The method of observation was the same as followed in the previous year. The data was analysed by 'Student's' method.

Blossom Berry Observations

Month	1953 % age berry retention in branches having		1954 % age berry retention in branches having	
	All leaves (Type A)	Less leaves in the same no. of nodes (Type B)	All leaves (Type A)	Less leaves in the same no. of nodes (Type B)
April	—	—	100.00	94.00
May	92.8	80.8	86.43	86.60
June	80.1	61.1	69.58	61.70
July	62.0	55.4	58.69	38.26
August	51.6	45.1	38.57	34.92
September	43.1	33.1	36.37	32.33
October	43.1	33.1	38.56	31.53
General Mean	62.12	51.62	61.17	54.19
Significant or not		Yes		Yes
S.E.M. per cent		1.666		2.434

This year also significant results are obtained. Plants having more leaves retained more fruits than the ones with less leaves.

(2) To observe the fruitfulness of the selections bred at the Coffee Research Station, Balehonnur, a set of blossom berry observation was commenced in March 1954 and completed in October on ripening of the fruits. Five selections were marked and six random branches on all these tagged. The blossoms on all the nodes of these branches were first noted and then the monthly berry counts taken.

Following table gives the details:

Blossom Berry Observations on Selections (1954)

	Mean per cent of retention of berries per plant (average of 10 branches) during the month of (1954)						
PLANT	*April*	*May*	*June*	*July*	*Aug.*	*Sep.*	*Oct.*
S.854 (2nd Sf. Gen. of S.44)	100.00	89.26	72.33	31.21	25.97	25.97	24.33
S.850 (F^2 of Kent × S.288-53)	100.00	97.68	80.00	41.23	25.74	25.74	24.00
S.845 (F^2 of S.288-53 × 288-23)	100.00	92.15	66.27	28.28	21.97	20.88	20.88
S.839 (3rd Sf. Gen. of S.26)	100.00	94.25	80.72	48.21	44.57	43.43	43.43
S.821 · (S.26 × S.26 × Kent)	100.00	96.23	80.22	48.06	46.67	46.67	40.62
Mean	100.00	93.91	76.03	39.52	32.98	32.54	30.65

The very low percentages of berries retained at the ripening stage is due to the fact that there was severe 'wet-feet' effect in these selections, consequently resulting in heavy leaf-shed and berry drop. This is particularly noticeable in July when there is a sharp fall in the percentages.

(3) *Blossom berry observations on selections* (1955)

To study the fruitfulness of some important Station Selections, this observation was started. Five plants in each selection were noted and ten branches tagged in each plant. The observations will be made till the ripening.

Blossom Berry Observations on Selections (1955)

Sl. No.	*Plants*	*Percentage of berry-retention*		
		April	*May*	*June*
1	S.288	91.40	67.52	55.24
2	S.333	97.50	90.13	75.35
3	S.645	75.73	76.68	62.52
4	S.795	71.88	82.41	62.91
5	Kent	73.62	46.39	31.03
	Mean	82.03	72.63	57.41

VII. Studies on the germination in arabica coffee seeds (Coffee Research Station, Balehonnur, Mysore State)

An experiment with arabica coffee seeds was started in December 1954 to study the viability of germination with the parchment cover (*a*) intact (*b*) partially split and (*c*) completely removed.

Three different sets of experiments were carried out. In set I, the seeds were sown immediately on pulping without storing. In set II, seeds were dried in the shade for a week and then sown. In set III, which is repeated at monthly intervals, the seeds were stored in (*i*) air-tight tins and (*ii*) in gunny bags. The seed material used was S.288. There were 20 seeds in each replication and five replications in each treatment.

Details are given in the following tables:

Seeds sown immediately on pulping

Symbol	*Treatment*	*Percentage of germination*	*Remarks*
A	Seeds sown with parchment cover split	93.0	*Layout:* ABBA 5 replications of 20 seeds each Sown on 15-12-1954
B	Seeds sown with parchment cover intact	98.0	
	General Mean	95.5	
	Significant or not	No	

Seed sown after drying in shade but without storing

Symbol	*Treatment*	*Percentage of germination*	*Remarks*
C	Treated with ash, sown with parchment cover split	94.0	*Layout:* Randomized
D	,, ,, removed	93.0	*Replication:* 5.
E	,, ,, intact	97.0	
F	Not treated ,, split	95.0	(of 20 seeds each)
G	,, ,, removed	97.0	*Date of sowing* 23-12-1954.
H	,, ,, intact	97.0	
	General Mean	93.99	
	Significant or not	No.	
	Critical difference	7.27	
	S.E.M. per cent	3.48	

Seeds sown after storing at monthly intervals

Symbol	*Treatment*	*Percentage of germination of seeds* *3-1-'55 III set	4-2-'55 IV set	1-3-'55 V set	*Remarks*
I	Ashed and stored in tins; sown with cover split	96.0	91.0	96.0	
J	,, ,, removed	96.0	92.0	85.0	
K	,, ,, intact	92.0	93.0	99.0	
L	Not ashed but stored in tins, sown with cover split	98.0	95.0	85.0	
M	,, ,, removed	97.0	94.0	100.0	
N	,, ,, intact	97.0	88.0	93.0	
O	Not ashed but stored in gunny; sown with cover split	92.0	97.0	83.0	*Layout:* Randomised.
P	,, ,, removed	92.0	98.0	86.0	
Q	,, ,, intact	94.0	87.0	70.0	
R	Ashed and stored in tins; sown with cover split	94.0	89.0	94.0	*Replications:* 5.
S	,, ,, removed	94.0	94.0	81.0	(of 20 seeds
T	,, ,, intact	92.0	89.0	68.0	each)
	General Mean	94.5	92.25	86.66	
	Significant or not	Yes	Yes	No	
	Critical difference	13.59	20.46	29.47	
	S.E.M. per cent	6.93	10.69	15.04	

* Date of sowing.

While varying methods of preservation or sowing do not seem to influence total effective germination, in all these cases, germination was definitely high, being over 90 per cent. The viability of seeds decreased as the stored period increased as is seen from the V set sown on 1-3-1955. It is noticed that seeds with parchment cover removed germinated about 15 days earlier, followed by the ones with split parchment cover. The last to germinate were the seeds with intact parchment coat. This confirms our earlier observation reported in 1952.

H. Hanumantha Rao
Agronomy Assistant

II. BOTANY

Work on coffee breeding with reference to leaf disease resistance and high yielding qualities was continued. (1) Production of seeds from selections and cross-breds for finding out the behaviour of the progeny regarding resistance to leaf disease and yield, (2) vegetative propagation of good bearers, (3) comparative trials of clonal plants from good bearers, (4) collection of plant material for establishing at the Station, both local and foreign, (5) morphological and cytological studies of selections, varieties and species of coffee, and (6) supply of seed coffee from selections to growers formed the principal work of the Division. During the year, coffee seed material was obtained by courtesy of (1) Director, UNESCO, Monrovia, Liberia, (2) Director, Institute National Pour L'Etude Agronomique Du Congo Belge, Station De Mulungu—Tshibinda, (3) Principal, School of Agriculture, Peradeniya, Ceylon, (4) Director, De La Section Technique D'Agriculture, Tropicale, 27 Rue, Oudinot, 27-Paris (7e), (5) Senior Research Officer, Coffee Research and Experimental Station, Lyamungu, Moshi, Tanganyika Territory, and (6) Head, Plant Pathology Department, Estacao Agronomica Nacional, Sacavem, Portugal.

A. COFFEE BREEDING

1. Arabica

Cross-breeding arabica coffee with a view to find out a good combination of parents as well as selfing of selected plants for raising further progeny were continued. Twelve intracrosses with selected arabica cultures were done. 31 plants were selfed; these were selected for their vigorous growth, field resistance to leaf disease and yield, from the 3rd and 4th generation of S.26, 2nd generation of S.31, S.44, S.72, S.73, S.178, S.179, F2. of S.26×Kents arabica, S.288×Coorg arabica, F2 and F3 of S.288×Kents arabica and S.31×S.22. The details of work done are given in Table B-1.

Note: During 1925-1930, 225 seed collections of arabica coffee were made from marked plants in estates in South India. The collections were planted in contiguous plots at the Station. Outstanding plants among these were selected and given identifying numbers S.1, S.2 ... S.80. These were selfed and also cross-bred with the arabica varieties Kents and Coorgs. The progeny raised from these were also given identifying numbers. Table B-II shows the origin of the selections which have been used for breeding work during 1954-55.

2. Field studies of advanced generations and hybrids

(*i*) Field studies on leaf disease resistance and high yielding characteristics of selections were continued. Eleven intra-crosses between arabica cultures were planted in contiguous plots in a block of 75 cents during September 1954. So far leaf disease is seen in the field upto 2.7 per cent in two intra-crosses.

(*ii*) A block of 75 cents was planted during August-September 1953, with seedlings from eleven Station Selections and three hybrids collected from a neighbouring estate, in strip plots laid out on a hedge-row system of planting. The distance between the rows is 9 ft., and between the plants in the row, 4 ft. The rows run along the contour of a slope of 30° incline. Dadap stakes have been planted for providing shade. All the plants appear to be so far free from leaf disease in the field except upto 10 per cent plants in each of four cross-breds: S.31×S.22, S.645 1/4×S.583 1/9, S.580 2/13×S.26 and S.580 2/13×S.645 1/4. The first production of blossom buds was rubbed off.

(*iii*) A block of 50 cents was planted during September 1952 on a hedge-row system of planting. 480 plants of S.795, 99 plants of S.333, 218 plants of F_2 of S.26 × Kents arabica and 5 intra-crosses with arabica cultures were planted. The distance between the rows is 9 ft. and between the plants in the row is 4 ft. 1 per cent plants of S.333 have shown leaf disease in the field. During the year flowers buds on green-wood were rubbed off and those on brown-wood retained.

(*iv*) Seedlings of 9 intra-crosses with selected arabica cultures and F_2 progeny of 2 arabica selections cross-bred with Kents arabica have been raised in the nursery for planting during the coming year.

3. Comparative trials of clonal progeny

(*i*) Clonal progeny of 20 arabica cultures of known yield, vigour and resistance to leaf disease of the B.A. series were planted during 1951 and 1952 in a randomised replicated experiment. All the plants are free from leaf disease in the field. Replicates planted during 1951 gave the first crop. The average plot yield in terms of clean coffee per acre is given in the following table:

Locality:	Balehonnur (Mysore)	*Lay-out:*	Randomised block
Variety:	Arabica hybrids	*Plot:*	3 plants in a row
Treatments:	20 cultures of B.A. series	*Guard rows:*	One on either side
Replications:	8	*Spacing:*	6 ft. by 6 ft.
		Shade:	Natural shade.

Area of the experimental block: 59.5 cents.
Treatments: 20 cultures of the B.A. series are:

B.A. 5	B.A. 19	B.A. 24	B.A. 31
B.A. 6	B.A. 20	B.A. 25	B.A. 32
B.A. 11	B.A. 21	B.A. 26	B.A. 34
B.A. 12	B.A. 22	B.A. 27	B.A. 35
B.A. 13	B.A. 23	B.A. 30	B.A. 36

Mean plot yield of three replications—calculated clean coffee in cwts. per acre (1200 plants)

Culture	*Yield*	*Culture*	*Yield*	*Culture*	*Yield*	*Culture*	*Yield*
B.A. 5	0.60	B.A. 19	5.76	B.A. 24	1.14	B.A. 31	2.85
B.A. 6	1.05	B.A. 20	3.15	B.A. 25	1.44	B.A. 32	1.08
B.A. 11	2.25	B.A. 21	0.96	B.A. 26	0.75	B.A. 34	1.41
B.A. 12	5.22	B.A. 22	2.43	B.A. 27	1.05	B.A. 35	2.61
B.A. 13	2.79	B.A. 23	3.45	B.A. 30	0.48	B.A. 36	2.04

(*ii*) Clonal progeny of 15 arabica cultures of known yield, vigour and resistance to leaf disease of the B.A. series and seedling progeny of B.A. 19 were planted during 1952 and 1953 in a randomised replicated experiment. All the plants are free from leaf disease in the field. During the year flower buds on green-wood were rubbed off and those on brown-wood retained. The lay-out is given below:

Locality:	Balehonnur (Mysore)	*Lay-out:*	Randomised block
Variety:	Arabica hybrids	*Guard row:*	One on either side
Treatments:	16 cultures of the B.A. series	*Spacing:*	6 ft., by 6 ft.
		Shade:	Natural shade
Replications:	6	*Area of experimental plot:*	45 cents

Treatments: 16 cultures of the B.A. series are:

B.A. 1	B.A. 8	B.A. 13	B.A. 16	B.A. 28	B.A. 19 (seedlings)
B.A. 4	B.A. 9	B.A. 14	B.A. 17	B.A. 29	
B.A. 7	B.A. 10	B.A. 15	B.A. 18	B.A. 33	

Note: During 1949-50, individual yields recorded for the Station selections through many years was studied. 36 best yielding plants were marked

1

S. 288 Arabica

2

S. 795 Arabica

3

S. 333 Arabica

among the self-bred progeny of the original station selections bearing identifying numbers S.26, S.31, S.44, S.47, S.58, S.61, S.73, S.178 and S.179, and cross-bred progeny of S.26 × Kents arabica and S.31 × S.22. These 36 plants were marked B.A.1, B.A. 2 . . . B.A. 36 (B.A. stands for Balehonnur Arabica), to differentiate them from identifying numbers given to the original Station Selections. The following table shows the origin of the 36 plants of the B.A. series from among the original Station Selections.

Mother plant	*Progeny from which selection was made*		*No. given in B.A. series*
S.26			B.A.35
	1st Generation	S.288	B.A. 1, B.A. 2, B.A. 3
	,,	S.329	B.A. 4, B.A. 5, B.A. 6
	,,	S.526	B.A. 33
	F1 of S.26 × Kents arabica	S.327	B.A. 8, B.A. 9, B.A. 10 B.A. 11, B.A. 12
S.31			B.A. 36
	2nd Generation	S.644	B.A. 20
	F1 of S.31 × S.22	S.333	B.A. 13, B.A. 14, B.A. 15, B.A. 16, B.A. 17, B.A. 18
	F2 of S.31 × S.22	S.645	B.A. 19
S.44	1st Generation	S.353	B.A. 26, B.A. 27, B.A. 28
	2nd Generation	S.576	B.A. 29
S.47	2nd Generation	S.580	B.A. 30
S.58	1st Generation	S.370	B.A. 7
S.61	1st Generation	S.373	B.A. 32
S.73	1st Generation	S.434	B.A. 34
S.178	1st Generation	S.583	B.A. 21, B.A. 22, B.A. 23, B.A. 24 B.A. 25
S.179	1st Generation	S.585	B.A. 31

4. Character studies of arabica selections

A description of S.288, S.795 and S.333 which are being increasingly grown in cultivation is given below:

(*i*) **S.288:** S.288 is the self-bred progeny of S.26, a plant selected from the collection from Doobla Estate in West Mysore. It is a vigorous spreading plant having primary branches 4 to 6 ft. in length. The internodes are short, being 1.5 to 3.4 inches long. The leaves are linear-oblong, thick and leathery, dark green and shining with wavy margin and longish acuminate tip. The young unfolding leaves are light-green to copper in colour. The fruits are borne in clusters. Fruits are roundish to roundish-oblong with a broad navel, flush, sometimes with persistent calyx lobes. Beans are roundish to roundish-oblong, coated, greyish to bluish-grey in colour. Upto 25 per cent plants may show susceptibility to races I and II of leaf disease to which Coorgs and Kents arabica are respectively susceptible. (Picture 1.)

(*ii*) **S.795:** S.795 is the progeny of a cross between S.288 and Kents arabica. It has vigorous growth and spreading habit. The primary branches are 4 to 6 ft. in length. In the earlier stages, the primary branches on some plants grow at an acute angle; they later bend down and spread out. The internodes are short being 1.5 to 3.5 inches long. The leaves are linear-oblong thick and leathery, dark-green and shining with pronouncedly wavy margin, and longish acuminate tip. The young unfolding leaves are brown to copper in colour. The fruits are in clusters. Fruits are oblong with a small to broad navel, flush, sometimes with persistent calyx lobes. Beans are oblong, bold and bigger in size than those of S.288, coated, greyish to bluish-grey in colour. Upto 25 per cent plants may show susceptibility to races I and II of leaf disease to which Coorgs and Kents arabica are respectively susceptible. (Picture 2.)

(*iii*) **S.333:** S.333 is the cross-bred progeny of S.31 × S.22. S.31 is a sister plant of S.26 being selected from the collection from Doobla Estate in

West Mysore. S.22 is a plant selected from a collection of Coorg arabica from Buskul Estate in North Mysore.

S.333 is characterised by vigorous growth, a spreading habit having long primary branches 4 to 6 ft. in length. The internodes are short being upto 3.1 inches long. The leaves are very dark-green in colour, thick and leathery, shining, linear-oblong to oblong, sometimes with a broad rounded base. Leaf margins are straight to broadly wavy. The young unfolding leaves are brown to copper in colour. Fruits are borne in clusters; are roundish to roundish-oblong with a broad navel, flush. Beans are roundish to roundish-oblong, not or slightly coated, deep blue in colour. Upto 10 per cent seedlings have a tendency to produce temporary chlorosis in the nursery stage. Upto 25 per cent plants may show susceptibility to I and II races of leaf disease to which Coorgs and Kents arabica are respectively susceptible. (Picture 3.)

The chromosome numbers of all the three selections are 2n=44, and the divisions appear to be regular.

5. Observational studies on leaf disease resistance and productive capacity of selections from estates

(*i*) 360 seedlings raised from seeds collected and 89 clonal plants raised from suckers collected in the earlier years from marked outstanding plants in six private estates in Mysore State and Shevaroys, Madras State, were planted at the Station in contiguous plots for observational studies on leaf disease resistance, vigour and production. All the plants are having vigorous growth. 5 to 8 per cent plants from the collections from Kurkenmutty Estate, Mysore State, 14 to 42 per cent plants from the collections from Lalbagh Estate, Mysore State, and 4 per cent plants from the collections from Moganad Estate, Shevaroys, Madras State, are showing leaf disease susceptibility in the field. During the year, blossom buds on green-wood were rubbed off and those on brown-wood retained.

(*ii*) 700 seedlings raised from seeds collected from selected plants in (1) a plot of Kents arabica in Vasambadi Estate, Shevaroys, Madras State; (2) Moganad Estate and Glen Peak Estate, Shevaroys, Madras State; and (3) Adarwally Estate, Mysore State, were planted during September 1954. Collections from Vasambadi Estate, Shevaroys, Madras State, are showing 3 per cent susceptibility to leaf disease in the field.

(*iii*) Collection of seed material from outstanding plants in private estates was continued. 200 seedlings have been raised out of collections from Woger Estate, Mysore State, and Kogilahalla Estate in Coorg.

6. Inter-specific crosses

(*i*) Three inter-specific crosses and their reciprocals were done during March-April, 1955, between C. stenophylla, C. liberica and C. robusta (C. canephora). F 1 seedlings of crosses between C. arabica, C. robusta (C. canaphora), C. liberica and C. eugenoides have been raised in the nursery for planting during the coming year.

(*ii*) Robusta selection S.274 was cross-bred with Kents arabica and 11 F1 seedlings established in 1938. The F1 seedlings have shown field resistance to leaf disease. One plant was crossed back to Kents arabica and 48 seedlings established in 1943. 75 per cent seedlings in this back-cross showed resistance to leaf disease in the field. They had negligible yield. One plant was crossed with Kents arabica and 5 seedlings of the 2nd back cross were planted in September 1954. So far they are free from leaf disease in the field.

(*iii*) Progeny from a natural robusta—arabica hybrid have been raised on 4 acres in Devamachy plot in Margolly Estate, Coorg. The plants show wide variability in all characters. Seeds from healthy and vigorous plants resistant to

leaf disease in the field and carrying a heavy crop were collected and established on the Station during 1951-52. These plants have vigorous growth and are free from leaf disease in the field. Ten crosses with arabica selections of the Station were done during March-April, 1953, and 279 seedlings raised were planted in contiguous plots during 1954 and 1955. One cross is showing susceptibility to leaf disease upto 2.1 per cent in the field.

7. Robusta

Comparative trials of clonal plants from best performers

(*i*) Clonal progeny of the robusta cultures in the B.R. series were planted in randomised replicated experiment durng 1951 and 1952. The lay-out is given below:

Locality:	Balehonnur (Mysore)	*Lay-out:*	Randomised block
Variety:	Robusta	*Plot:*	3 plants in a row
Treatments:	10 cultures of the B.R. series	*Guard row:*	One on either side
		Shade:	Natural shade
Replications:	Nine	*Area of the experimental block:*	96 cents
Spacing:	9 ft. by 9 ft.		

Treatments: Ten cultures of the B.R. series are: B.R. 2, B.R. 3, B.R. 5, B.R. 6, B.R. 7, B.R. 9, B.R. 11, B.R. 12, B.R. 15, B.R. 17.

(*ii*) Clonal progeny of nine robusta cultures of the B.R. series and seedling progeny of S.274 were planted during 1952 and 1953 in a randomised replicated experiment. The lay-out is given below:

Locality:	Balehonnur (Mysore)	*Lay-out:*	Randomised block
Variety:	Robusta	*Plot:*	3 plants in a row.
Treatment:	10 cultures of B.R. series	*Guard rows:*	One on either side
		Shade:	Natural shade
Replications:	Eight	*Area of the experimental block:*	93 cents
Spacing:	9 ft. by 9 ft.		

Treatments: Ten cultures of the B.R. series are: B.R. 1, B.R., 4, B.R. 6, B.R. 8, B.R. 10, B.R. 13, B.R. 14, B.R. 16, B.R. 17, and Seedling progeny of S.274.

8. Collection of coffee seed material from foreign countries

(*i*) Seed material was continued to be received from foreign Institutions. Details of seedlings raised from the seeds thus received during the year 1954-55 are given below:

Species	*No. of seedlings raised*	*Seed material received from*
C. robusta	15	Director, UNESCO.
C. liberica	20	Monrovia, Liberia.
Coffee arabica varieties:		
Green lipped	70	Director, Institute National Pour L'Etude, Agronomique Du Congo Belge, Station De Mulungu Tshibinda, Mulungu, Belgiam Congo.
Las Palmas	70	
Barbarina ..	70	
Coorg ...	60	
Porto Rico	50	
Antique	70	
Granja Blonay (colombie)	70	Director, Institute National Pour L'Etude, Agronomique Du Congo Belge, Station De Mulungu Tshibinda, Mulungu, Belgiam Congo
Tumbadir	70	
Local bronze de Mulungu	60	
Mibirizi De Mulungu	50	
Species		
Coffee robusta Laurentii	100	Principal, School of Agriculture, Peradeniya, Ceylon
Coffee liberica Arnoldiana	100	
Coffee liberica Aruwimiensis	100	

Coffee arabica varieties	*No. of seedlings raised*	*Seed material received from*
Cundinamarca	100	Director De La Section Technique D'Agriculture Tropicale, 27, Rue Oudinot, 27—Paris (7 e)
Madagascar	100	
Costa Rica	100	
Martinque	60	
Guinee Pita	70	
Colombie	30	
Togokouma	80	
Darnum	70	
San Salvador	80	
Laurina	70	Senior Research Officer, Coffee Research and Experimental Station, Lyamungu, Moshi, Tanganyika Territory
Sudan Barbuk	60	
Mibirizi	40	
Geisha	50	
Amphillo	60	
Padang	75	
Erecta	60	
San Ramon	55	
Maragojipe	60	
Species		
Coffea eugenoides	60	Head, Plant Pathology Department, Estacao Agronomica Nacional, Sacavem, Portugal
,, salvatrix	15	
,, 'Kapakata'	7	
,, ligustroides	35	
,, racemosa	54	
COF. 290 Mosambi	24	
COF. 292 F.1	8	

C. arabica var amphillo has been stated to have a high degree of resistance to leaf disease from studies at the Coffee Research and Experimental Station, Lyamungu. *C. salvatrix* is 'also apparently resistant to leaf rust' (20th Annual Report, 1954, Coffee Research and Experimental Station, Lyamungu). C. *arabica varieties Geisha* and *Mibrizi* have been reported to be highly resistant to leaf disease from studies done at Estacao Agronomica Nacional, Sacavem (unpublished).

(*ii*) 1,600 seedlings raised from seeds received from foreign countries during 1954 consisting of 31 varieties of arabica, *Coffea stenophylla, Kawisari B and D, C. canephora, C. Dewcerei, C. Dewverei excelsa* were planted in June 1955 along with 300 seedlings of Station Selections of arabica. Among the varieties of arabica planted K.7 (seeds received from Coffee Research Station, Department of Agriculture, Kenya) has been reported as showing a high degree of resistance to leaf rust from studies done at Estacao Agronomica Nacional, Sacavem (unpublished). So far this variety appears to be free from leaf disease. Upto 14 per cent leaf disease susceptible plants have been noticed in C. arabica varieties, Dilla Melville, Dilla (mixed), Gimma M'buni, Gimma Galla Sidamo, Costa Rica, Colombie, Macenta, Salvador, Kouti, Kenya, MKongoum, Nicaragua, Mazeron, S.17 Yrgalem and Station Selections S.645 and S.327.

(*iii*) 3,697 seedlings raised from seeds obtained from foreign countries during 1953 were planted in contiguous plots during June 1954 along with Station Selections S.288 and S.446. These consist of 27 varieties of arabica, 7 arabica selections of Coffee Research and Experimental Station, Lyamungu, and Kawisari D. The plants were protected with Bordeaux mixture spray against leaf disease as most of them showed susceptibility to leaf disease. Comparatively S.288 was free from the disease.

(*iv*) 140 seedlings of 5 varieties of arabica, *Bourbon amarelo, Bourbon Vermelho, Caturra amarelo, Laurina maragogype* and *Mundo Novo*, were received from the Economic Botanist, Specialty Crop Introductions, U.S. Department

of Agriculture, and planted during September 1953 along with four Station Selections. It is noticed that under conditions at the Station, all the five varieties and upto 10 per cent plants in the Station Selections show susceptibility to leaf disease in the field.

(*v*) Collections of coffee plant material received from foreign institutions from 1953 consists of 77 varieties of arabica, 8 arabica selections, 4 varieties of liberica, three varieties of robusta, two varieties of excelsa, Kawisari B. and D, congensis, stenophylla, eugenoides, racemosa, salvatrix, 'Kapakata' and ligustroides.

9. Extension work with selections

(*i*) A block of 5.66 acres was planted to continuous plots of S.795, S.947, S.532, S.846 and S.645 during September 1954 to establish seed blocks of these selections with a view to augment the seed production from the Station.

(*ii*) During the year 911 lb. seeds of arabica selections and 834 lb. seeds of robusta were supplied. The following table shows the quantity of seed coffee distributed from 1949:

Year	*Arabica selections*	*Kents arabica*	*S.274 robusta*	*Robusta*	*Excelsa and liberica*	*Total*
	lb.	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*
1949	150	262	62	759	2	1235
1950	253	173	47	506	...	979
1951	400	366	40	1046	1	1853
1952	695	80	45	1139	...	1959
1953	888	45	35	875	9	1852
1954	1456	20	106	720	31	2333
1955	911	...	77	757	39	1784

(*iii*) 4 oz. seeds of each of S.532 and S.846 were supplied to (*a*) planter members of the Research Committee of the Coffee Board, (*b*) planter members of the *ad hoc* committees for Coffee Research Station, Balehonnur, and Coffee Research Sub-Station, Chethalli, (Coorg) and (*c*) 18 planters in Shevaroys, Madras State, for raising trial plots of the two selections.

(*iv*) 55 lb. seed coffee of arabica selections S.288, S.795, S.333, S.645, S.576, S.446 and S.274 robusta were supplied to ten institutions outside India.

A list of foreign institutions to which seeds of Station Selections were supplied, is given below:

(1) N. Quisumbing, Esq., Oriental Packing Co., Manila, Philippines, (2) Senior Research Officer, Coffee Research and Experimental Station, Lyamungu, Moshi, (3) Principal, School of Agriculture, Peradeniya, Ceylon, (4) Director, UNESCO, Monrovia, Liberia, (5) A. G. Newhall, Esq., University of the Philippines, College of Agriculture, Central Experimental Station, Laguna, Philippines, (6) Directeur De la Section, Technique d' Agriculture Tropicale, Paris (7e) (7) U.S.A. Operation Mission to the Philippines, American Embassy, Manila, Philippines, (8) U.S.A. Operation Mission to Thailand, American Embassy, Bangkok, Thailand, (9) Economic Botanist, U.S. Department of Agriculture, Agricultural Research Station, Beltsville, Maryland, U.S.A., (10) J. K. Robertson, Esq., Linjidzi Estate, Blantyre, Nyasaland.

(*v*) The demand for seed coffee from Station Selections is on the increase. During 1953-54, to meet the increased demand, nine planters in Mysore and Coorg States very kindly agreed to supply seeds from blocks of Station Selections existing on their estates to such of the indents that were referred to them. By this arrangement, it was possible to supply about 660 lb. seeds of Station Selections. During the year under report, it was considered desirable to develop zonal seed blocks so that seed material could be obtained in larger measure for supplies. It was felt that seed raised in the zone would perhaps be of greater

use as aclimatised material for the zone. It was considered that the compact blocks of selections existing in many estates may be developed for the purpose of seed development programme. The scheme of establishing zonal seed plots was also approved by the Research Committee of the Coffee Board. The following 18 estates very kindly co-operated with the Department in establishing seed plots of Station Selections. Off-type plants in these seed plots were rogued out and seed coffee prepared under Departmental supervision. 3,078 lb. seeds were supplied from these plots.

Mysore

1. Sri U. K. Lakshman Gowda, Urvinkan Estate, Javali P.O.
2. Manager, Yellikodige Estate, Aldur P.O.
3. W. W. Woodbridge, Esq., Bettadamane Estate, Mudigere P.O.
4. Sri Patre K. Chennaveerappa, Mandalkan Estate, Santaveri P.O.
5. Sri S.N. Ramanna, B.A., LL.B., Byneheddal Estate, Chikmagalur P.O.
6. Lokasevaniratha Sri M. S. Dyave Gowda, Gundicad Estate, Koppa P.O.
7. Miss E. Thomson, Archullie Estate, Mudigere P.O.
8. Janab Mohammed Salar, Hiregurje Estate, Arehalli P.O.
9. Manager, Barguai Estate, Saklaspur P.O.
10. Sri B. Siddanniah, Daithapura Estate, Ballupet P.O.

Coorg

11. Sri D. V. Dasappa, Balagunda Estate, Somwarpett P.O.
12. Sri K. H. Srinivasan, M.A., B.Sc., (Edin.), Kibbetta Estate, Somwarpett P.O.
13. Sri G. M. Manjanathayya, Haradoor Estate, Suntikoppa P.O.
14. Manager, Santagerry Estate, Suntikoppa P.O.
15. Manager, Madapur Group Estates, Madapur P.O.

Nilgiri-Wynaad—Madras State

16. Manager, Glenvans Estate, Ouchterlony Valley Estates (1938) Ltd., New Hope P.O.

Shevaroys—Madras State

17. N. M. Hight, Esq., Moganaad Peak Estate, Nagalur P.O.
18. C. L. Hight, Esq., Cauvery Peak Estate, Nagalur P.O.

(*vi*) During the year under report, 2,343 lb. seeds of arabica selections and 877 lb. seeds of robusta from the two Stations, and 3,078 lb. seeds of arabica selections from the zonal seed blocks were supplied to 1,247 planters. This quantity of seed material is considered sufficient for planting an area of 5,421 acres with arabica selections and 1,752 acres with robusta at the rate of 1 lb. seed per acre in the case of arabica and for two acres in the case of robusta.

Note: From observations at the Station, it is noticed that 75 per cent seedlings of S.288, S.333, S.645 and S.795 show resistance to races I and II of leaf disease, *Hemileia vastatrix B and Br.* that affect Coorgs and Kents arabica respectively. 25 per cent show susceptibility to these races. In the plots of these selections raised in the estates, the leaf disease susceptible plants have been noticed to occur upto 15 per cent.

The selections may get attacks of *Black-rot*, *Pellicularia* (*Corticium*) *koleroga* (*Cooke*) *V. Hohnel* and '*Brown-Eye-Spot*', *Cercospora coffecola*. B. and Cke. To control these diseases, spraying with Bordeaux mixture at 2:2:40 strength is advocated.

B. VEGETATIVE PROPAGATION

10. Grafting

(*i*) *Top-working:* (*a*) Trials were commenced to find out an easy technique for top-working robusta coffee plants with scion wood from high yielding leaf disease resistant arabica selections. 535 robusta plants were stumped during May 1954, and three suckers per plant were raised. At the same time, two suckers per plant were allowed to grow on high yielding vigorous plants of S.288 (3rd generation) for scion wood. During May-June 1955, one sucker on each of 267 robusta plants was grafted at a height of 6 to 9 inches from ground level and one sucker on each of 268 robusta plants was grafted at a height of 2 to 2¼ ft., from ground level. Suckers on S.288 (3rd generation) were used as scion wood. Wedge-grafting technique was adopted. 1.8 per cent grafts were failures.

(*b*) As an exploratory trial, the top most primary branches on 43 robusta plants (topped at 2½ ft. from ground level), 3 year old, were cut and the main stem at this level was grafted with scion wood taken from suckers on S.288 (3rd gen.). Wedge-grafting technique was used. All the grafts have been successful. The advantage aimed at in this method is that during the period when arabica crown is being formed, crop may be obtained from the primary branches retained on the robusta stock.

(*c*) Grafting demonstration was held during May-June 1955 grafting season and was attended by 27 persons including Proprietors, Managers, Estate staff and labourers from estates in Mysore, Wynaad-Malabar and Travancore. Top-working technique as practised at the Station was demonstrated.

(*ii*) 574 robusta plants interplanted amidst arabica plots at the Station were stumped during May 1955, and three suckers per plant are being raised for top-working during May-June 1956.

(*iii*) *Frame-working:* Trials were conducted to find out a suitable technique for frame-working robusta coffee plants with scion-wood from good yielding leaf disease resistant arabica selections. A block of 595 robusta plants was utilised for the purpose. The work was done from May to August 1954. On each plant, 6 grafts were done on the primary and thick secondary branches using scion-wood from the secondary branches of S.288. Soft-wood, brown-wood and hard-wood scions were used. Side-grafting and whip-and-tongue technique were followed. 12.9 per cent grafts were successful.

11. Rooting of cuttings

458 clonal plants from (1) 15 arabica selections of the B.A. series, 3 robusta selections of the B.R. series, and (2) S.288, S.795, S.645 and S.46 were produced during the year.

C. MULTIPLE STEM VS SINGLE STEM SYSTEM OF GROWING COFFEE

12. Arabica

(*i*) *Experiment I:* The lay-out and the yield record of the plots on single and multiple stems are given below:

Locality:	Balehonnur (Mysore)	*Lay-out:*	AB, BA, pattern
Variety:	S.288, S.333, S.434, S.433 and Kents arabica (each variety having 12 rows of 16 plants in each row)	*Age of plants:*	6 years from seed
		Spacing:	6 ft., by 6 ft.
		Period of conversion to multiple stem:	May 1950
Treatments:	A. Single stem	*Area of experimental block:*	95.2 cents
	B. Multiple stem	*Shade:*	Natural shade

Yield of Ripe Cherry (actual) in lb. and clean coffee in cwts. calculated per acre (1200) plants

	A. *Single Stem*						B. *Multiple Stem*					
Year	S 288	S 333	Kents	S 433	S 434	Kents	Mean	S 288	S 333	Kents	S 433	S 434	Kents	Mean
1952														
Ripe Cherry	63	83	19	7	22	22	36	21	8	7	4	5	3	8
Cl. coffee	1.17	1.52	0.35	0.13	0.42	0.41	0.66	0.38	0.15	0.13	0.07	0.09	0.06	0.15
1953														
Ripe cherry	55	98	32	103	116	10	69	177	83	28	99	135	8	88
Cl. coffee	1.02	1.82	0.60	1.92	2.16	0.18	1.28	3.28	1.53	0.52	1.83	2.52	0.15	1.64
1954														
Ripe cherry	243	421	226	227	416	374	318	463	338	370	452	643	160	404
Cl. coffee	4.52	7.83	4.20	4.22	7.74	6.96	5.91	8.6	6.28	6.88	8.41	11.96	2.98	7.52
1955														
Ripe cherry	180	128	115	49	62	75	101	144	125	113	73	56	84	99
Cl. coffee	3.34	2.38	2.13	0.91	1.15	1.39	1.88	2.68	2.32	2.12	1.36	1.04	1.56	185
Mean														
Ripe cherry	135	182	98	97	154	120	31	201	138	129	157	210	64	150
Cl. coffee	2.51	3.39	1.82	1.80	2.87	2.24	2.44	3.74	2.57	2.41	2.92	3.90	1.19	2.75

Note: 6 lb. ripe cherry has been taken to yield 1 lb. clean coffee.

In the aggregate of 4 years yield, the multiple stem plots have recorded 14.5 per cent increase over the single stem plots. Individually among the varieties, S.333 single stem plot has given higher yields than the multiple stem plot in all the years. No stem borer infested plants were removed in either the single or multiple stem plots.

(*ii*) *Experiment II:* The lay-out and the average yield record of the plots on single stem and multiple stems are furnished below:

Locality:	Balehonnur (Mysore)	*Lay-out:*	Randomised block
Variety:	Arabica hybrids	*Plot:*	4 × 16 plants
Treatments:	4 during the year of conversion	*Spacing:*	6 ft. by 6 ft.
		Age of plants:	22 years from seed
Shade:	Natural shade	*Period of conversion:*	March 1951
Area of experimental block:	105.8 cents		

Treatments

A. Single stem.

B. Primary branches on one side were pruned off during March 1951 to encourage free growth of suckers for forming the multiple stems. After crop harvest, during March 1952, the main stem was stumped to a height of 2 ft. from the ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

C. Extended centring upto 1 foot from the centre was done during the year of conversion (1951) to facilitate free growth of 3 suckers for forming the multiple stems. After the crop harvest, during March 1952, the main stem was stumped to a height of 2 ft. from the ground level retaining a primary branch to form the lung branch. The three suckers form the multiple stems.

D. Except the two top primary branches all the other branches were cut down during the year of conversion (1951) to facilitate free growth of three suckers. After crop harvest during March 1952, the topmost primary branch was retained to act as lung branch and the three suckers form the multiple stems.

The growth of suckers for forming the multiple stems is observed to be the best in treatment B.

Mean yield of ripe cherry per plot (actual) in lb. and calculated yield of clean coffee in cwts. per acre (1200 plants)

Treatments	*Ripe Cherry (actual)*				*Clean coffee (calculated)*			
	1952 (*conversion year*)	1953	1954	1955	1952 (*conversion year*)	1953	1954	1955
	lb.	*lb.*	*lb.*	*lb.*	*cwt.*	*cwt.*	*cwt.*	*cwt.*
A	38.63	47.14	208.46	100.44	1.08	1.31	5.81	2.80
B	22.11	12.24	262.16	92.31	0.62	0.34	7.31	2.58
C	24.62	26.11	272.46	110.06	0.68	0.73	7.66	3.07
D	38.38	34.73	246.84	99.38	1.07	0.97	6.77	2.75

Note: 6 lb. ripe cherry has been taken to yield 1 lb. clean coffee. After crop harvest, during February-March 1955, the lowest pairs of primary branches were pruned off on the multiple stems. No plant in single stem or multiple stem plots was damaged during shade lopping or from stem borer infestation. Taking the aggregate of three years yield after conversion, treatments B, C and D have recorded 3.1 per cent,

15.5 per cent and 5.9 per cent increased yield respectively over Treatment A.

(*iii*) *Experiment III:* The lay-out and average yield record of the plots on single stem and multiple stems are given below:

Locality: Balehonnur (Mysore) *Lay-out:* AB, AB pattern
Variety: Arabica (Hybrid) *Plot:* 16 plants in a row
Treatments: 2 *Spacing:* 6 ft. by 6 ft.
A. Single stem *Age of plants:* 11 years from seed
B. Multiple stem *Shade:* Natural shade
Replications: 21 *Period of conversion:* March 1951
Area of the experimental block: 52 cents

Treatments	Ripe cherry per plot (actual)					Calculated yield of clean coffee per acre (1200 plants)				
	1952	1953	1954	1955	Mean	1952	1953	1954	1955	Mean
	lb.	lb.	lb.	lb.	lb.	cwt.	cwt.	cwt.	cwt.	cwt.
A. Single Stem	5.78	19.43	24.72	18.99	21.05	0.64	2.17	2.76	2.12	2.35
B. Multiple Stem	3.90	8.03	21.49	15.20	15.24	0.44	0.89	2.40	1.69	1.66

Note: 6 lb. ripe cherry has been taken to yield 1 lb. clean coffee.

After crop harvest, during February-March 1955, the lowest pairs of primary branches were pruned off on the multiple stems. No plant was damaged either in single or multiple stem plots during shade regulation or from stem borer infestation. Considering three years aggregate yield after conversion, treatment A has recorded 41.6 per cent increase over treatment B.

13. *Robusta:* The lay-out and average yield record of the plots on single stem and multiple stems are given below:

Locality: Balehonnur (Mysore) *Lay-out:* Opposite quadrants
Variety: Robusta on a rectangular block are on each
Treatments: 2 A. Single stem of the 2 treatments
B. Multiple stem *Spacing:* 9 ft. by 9 ft.
Replications: 2 *Shade:* Natural shade
Area of experimental block: 65.50 cents
Age of plants: 9 years from seed *Period of conversion:* Sept. 1951

Treatments	Ripe cherry per plot (actual)				Calculated yield of clean coffee per acre (538 plants)			
	1953	1954	1955	Average	1953	1954	1955	Average
	lb.	lb.	lb.	lb.	cwt.	cwt.	cwt.	cwt.
A. Single Stem ...	121.06	110.30	138.00	123.12	1.33	1.20	1.51	1.35
B. Multiple Stem	52.69	153.63	105.34	103.88	0.58	1.61	1.15	1.11

Note: 5 lb. ripe cherry has been taken to yield 1 lb. clean coffee.

In the aggregate of 3 years yield, the single stem plots have recorded 21.6 per cent increase over the multiple stem plots. The multiple stem plots had heavy shot-hole borer infestation. The infested branches were removed and destroyed.

14. *Laboratory Studies:* (*i*) Cytological studies on coffee were revived. Standard smear and paraffin embedding techniques were followed. As a first step, chromosome numbers of (1) selections under distribution, (2) varieties of arabica and (3) species other than arabica were recorded. Details of the chromosome counts recorded are given below.

Coffee arabica

Selections	*No. of chromosomes 2n =*
S.288	44
S.795	44
S.333	44
S.532	44
Varieties	
Coorg	44
Kent	44
Maragogype	44

Coffee species		*No. of chromosomes 2n=*	
Coffea	abeocuta	22	
,,	liberica	22	
,,	quillou	22	
,,	robusta	22	
,,	stenophylla	22	
,,	ligustroides	22	
,,	robusta Laurentii	22	*
,,	liberica Arnoldiana	22	*
,,	liberica Aruwimiensis	22	*

* collections received from Principal, School of Agriculture, Peradeniya, Ceylon.

The chromosome numbers of *Coffea arabica*, *maragogype* and *Coffee* species correspond with similar observations recorded by workers in other countries. A rare occurrence of a tetraploid plant in each of C. liberica, C. congensis and C. bengalensis (2n=44) is recorded.

(*ii*) The chromosome number of the F. 1 of a cross between C. robusta and Kents arabica was noticed to be 2n=33. Among the first back-cross progeny with Kents, plants having 2n=44 and 55 chromosomes have been recorded.

D. MISCELLANEOUS CROPS

(*i*) *Green manures:* Specimen plots of the following green manures were continued:

Crotalaria anagyroides	Desmodium ovalifolium
,, usaramoensis	Calopogonium mucunoides
,, Grahamiana	Centrosema pubescens
,, Browne	Stylosanthes gracilis
Tephrosia candida	Mimosa invisa
,, vogelii	Pueraria javanica

40 lb. seeds of green manure and cover crops were supplied to indentors during the year.

(*ii*) *Shade trees:* **Maesopsis eminii** have grown to fairly good sized trees. They produced fruits during the year. 6 lb. seeds collected were supplied to indentors.

R. L. NARASIMHASWAMY
Botanist

TABLE B. 1. Breeding of Coffee at Balehonnur (Mysore) (Arabica)

Method	*Purpose*	*Procedure adopted*
1. Hybridisation between two desirable parents	To secure best combination to produce vigour, resistance to leaf disease and high yield	1. 583 1/1 × 576 2/1 2. (a) 583 2/1 × 333-4 and reciprocal (b) 583 2/1 × 576 1/2 and reciprocal (c) 583 2/1 × 327 26/1 3. (a) 576 1/2 × 333-4 (b) 576 1/2 × 327 1/2 4. 576 2/1 × 333-15 5. (a) 333-4 × S.46 (b) 333-4 × 905 1/7 and reciprocal 6. 795 3/10 × 583 1/7 7. (a) 795 3/11 × 583 1/1 (b) 795 3/11 × 576 2/1

2. Selfing of desirable parents	For raising further progeny	1. *III Generation of* S.26: 948 1/10d and 2/3 2. *IV Generation of S.*26: 951 2/1 and 3/3 3. *II Generation of S.*31: 644 1/13 and 1/7 4. *II Generation of S.*44: 576 1/2 and 2/1 5. *II Generation of S.*72: 984 1/9 and 1/16 6. *II Generation of S.*73: 985 1/15 and 2/10 7. *II Generation of S.*178: 862 1/1 8. *II Generation of S.*179: 863 2/2 9. *F2 of S.*26 × *Kents arabica*: 532 3/1, 3/2 and 3/8 10. *F2 of* 288 × *Kents arabica* (*a*) 846 2/3 (*b*) 795 1/2, 3/7 11. *F2 of S.*288 × *Coorg arabica*: 737 1/5 and 2/4 12. *F3 of S.*288 × *Kents arabica* (*a*) 1403-12 (*b*) 1405-54 (*c*) 1406-40 (*d*) 1407-30 13. *F2 of S.*31 × S.22: 645 1/6, 1/10 and 5/9 14. *F3 of S*31 × S.22: 1411-15

TABLE B. II. Origin of selections used for Breeding Work During 1954-55

Collection	*Mother plant selection*	*Progeny*	
Doobla Estate, Mysore	S.26	1st selfed Generation	S.288
		3rd selfed Generation	S.948
		4th selfed Generation	S.951
		F1 of S.26 × Kents arabica	S.327
		F2 of S.26 × Kents arabica	S.532
		F2 of S.288 × Kents arabica	S.795, S.846
		F3 of S.288 × Kents arabica	S.1403, S.1405, S.1406 and S.1407
		F2 of S.288 × Coorg arabica	S.737
,,	S.31	2nd selfed Generation	S.644
Buskul Estate, Mysore	S.22	F1 of S.31 × S.22	S.333
		F2 of S.31 × S.22	S.645
		F3 of S.31 × S.22	S.1411
Kummergod Estate Mysore State	S.44	2nd selfed Generation	S.576
,,	S.72	2nd selfed Generation	S.984
,,	S.73	2nd selfed Generation	S.985
,,	S.178	1st selfed Generation	S.583
,,	S.178	2nd selfed Generation	S.862
,,	S.179	2nd selfed Generation	S.863
Coffee Research Station, Balehonnur, Mysore State	S.46		

III. CHEMISTRY

FIELD EXPERIMENTS

A. Manurial Experiments

Experiments on the manurial requirements of coffee, land managements with special reference to soil and moisture conservation, influence of trace elements on yield and health factors and the quick processing of fruit by chemical means formed the main items of work of this Division. The Division also attended to routine examination of soils and manures for advisory work and visit to problem areas for investigation and advice on soil and crop husbandry. Soil survey of representative areas in the different coffee zones particularly in relation to the micro-climatic conditions was also continued.

(*i*) Studies on the essential requirements of plant foods N.P.K. for coffee in relation to improvement in yield (New Manurial Series)

This experiment laid out in 1937 at the main Research Station was continued. Nitrogen, phosphoric acid and potash were given individually or in varient combinations at defined levels of 60 lb. N, 30 lb. $P_2 O_5$ and 40 lb. $K_2 O$ to the acre. During the original planting, the coffee plants were planted $5' \times 5'$ in the sub-plots. This distance proved to be too small as years rolled by and, the plants had over-grown each other, and started producing only gormandizer growth. In order to provide greater lateral space for the plants to enable them to make full use of the plant nutrients given, the number of plants in each sub-plot was reduced from 40 to 20 by removal of alternate plants in each row so that a triangular pattern of planting resulted.

The yield record of the experiment and the percentage of floats in the harvest are given in Table C.I.

For the first time in the history of the plots, a very high yield of the order of approximately half a ton of clean coffee per acre has been recorded. The treatments, though not statistically significant, high numerical yields in terms of both cherry and clean coffee have been obtained from Tr. B (NP) with Trs. D (NPK) and C (NK) closely following. Treatments A (N only) and E (Control) are next in order. In the report for the year 1953-54, analysis of the average yield of ripe cherry and clean coffee was given for a period of 14 and 6 years respectively. Extending this analysis to cover a period of a further year, Tr. D (NPK), C (NK) and B (NP) are seen to be significantly superior to Tr. E (Control) but not to Tr. A (N only). The treatments amongst themselves are not significant. In the analysis of the clean coffee figures—average over 7 years —Trs. B (NP), D (NPK), C (NK) and A (N only) are all significantly superior to Tr. E. (Control), but amongst themselves are not superior to one another.

It would appear as though the re-orientation of the manurial requirement was beginning to manifest itself.

In the determination of floats by weight, Trs. B (NP) and D (NPK) have higher percentage of floats and are significantly superior to Trs. A (N only) and E (control) but not to Tr. C (NK). Similar is the case in the determination of floats by volume. It is interesting to observe that in seven years during which determination of floats have been carried out, Trs B. (NP) and E (Control) have had the highest percentage of floats each in three years.

(*ii*) Studies on the manurial requirements of coffee in relation to improvement of yield

(a) *N.P.K. trials with varying levels of N.P. and K. (Fundamental manurial experiments in the pH cisterns)*

This experiment laid out in 1950 was continued. The yield record of the experiments and the percentage of floats in the harvest are given in Table C. II.

Tr. A (20-30-40) is seen to be significantly superior to Tr. D (30-45-40) in both cherry and clean coffee returns while Tr. B (30-30-40) narrowly misses significance in the cherry yield and is significantly superior to Tr. D. (30-45-40) in clean coffee determination. Trs. A and B are not significantly superior to Trs. F, C and E in the cherry yields, but are superior to Tr. E in clean coffee determination.

In the determination of floats by weight and by volume, Trs. D (30-45-40) and B (30-30-40) have significantly higher percentage of floats than Trs. E (30-45-60), C (45-30-40) and F (45-67½ -90). Tr. F has the lowest percentage of floats.

(b) *N.P.K. trials with varying levels of nitrogen with constant levels of P and K (17-acre, manurial experiments, 1952 series)*

This experiment started in 1952 was continued. In April 1955, the plants produced a blossom estimated at between 4-5 cwt. clean coffee per acre, but as the plants were still very young, the blossom on the green wood was all rubbed out leaving only just about 1-2 cwt. crop on the brown wood. The plants are beginning to close in.

(c) *N.P.K. trials with constant levels of N.P.K. but varying sources of nitrogen (17-acre, manurial experiments, 1953 series)*

This experiment started in July 1953 was continued.

(d) *N.P.K. trials with varying levels of P. and K but constant levels of nitrogen (17-acre, manurial experiments, 1954 series)*

This experiment started in July 1954 was contined.

(e) *Comparative trials on the influence of different forms of nitrogen on growth and yield of coffee (Experiments in rubber area)*

This experiment started in October 1953 was continued. The yield record of experiment is given in Table C. III. Treatments have not been statistically significant. Tr. A (Urea) has produced highest numerical yield followed by Tr. C (Ammonium sulphate nitrate) and Tr. B. (Calcium cyanamide).

(f) *N.P.K. trials with varying levels and combinations—(Arabica manurial experiment at Coffee Research sub-station, Chethalli)*

This experiment laid out in August 1952 was continued. The flower buds on the green wood of the plants were rubbed out as they are still only three years old. A crop of 1-2 cwt. is expected from this area during the current year.

(*iii*) Studies on the application of nitrogen only in divided doses in relation to yield of coffee: (Ossoor Manurial Experiments)

This experiment laid out in June 1953 in one of the private estates (Ossoor Estate, Saklespur-Mysore) was continued. Yield records of the experiment is given in Table C. IV. Treatments have not been significant in the cherry and clean coffee yields as well as in percentage of floats.

(*iv*) Field manurial trials on private estates on arabica

During visits to estates and discussions with planters a tendency amongst them to feel that application of higher levels of nitrogen than the usual 40 lb. to the acre with or without correspondingly increased levels of phosphoric acid

and potash produced higher yields was noticed. This is generally contrary to experience gained in other permanent fruit crops and certain common plant physiological conceptions. In order to check up this aspect of the question, field experiments were planned and laid out on the following estates to study the effect of the application of 40, 60, 80 and 100 lb. nitrogen alone to the acre and with 30 lb. $P_2 O_5$ to the acre and with 30 lb. $P_2 O_5$ and 40 lb. $K_2 O$ to the acre.

1. Merthikhan Estate, Mysore State.
2. Urvinkhan Estate, ,,
3. Bynecool estate, ,,
4. Togarihankal Estate, ,,
5. Karadibetta Estate, ,,
6. Sulgode Estate, ,,
7. Malambi Estate, Coorg.
8. Coffee Research sub-station, Chethalli, Coorg.
9. Maruvahalla Estate, Nilgiris, Madras State.
10. Vasambadi Estate, Shevaroys, Madras State.

The first year's yield data from the experimental plots have been recorded.

(*v*) Manurial experiments on robusta coffee

(a) *N.P.K. trials with varying levels and combinations.* (*Robusta manurial experiment at Coffee Research sub-station, Chethalli*)

This experiment was laid out in Sept. 1954 to find out the optimum combination of N, P, K needed for good growth and yield of robusta coffee under predominantly S.W. monsoon (average rainfall 70 inches per annum) conditions. An area of about 4 acres has been cleared free of all trees, etc. terraced and planted with clones raised for the purpose.

The experiment is laid out in the factorial design 4×2×2 with third order of interaction confounded; nitrogen at 4 levels, phosphoric acid and potash at 2 levels each with a total number of 48 sub-plots, each consisting of 20 plants 5×4 planted 13 ft. apart. Following are the treatments:

Nitrogen at 4 levels	N_0	= 0 lb. nitrogen to the acre.
	N_1	= 60 lb. ,,
	N_2	= 90 lb. ,,
	N_3	=120 lb. ,,
Phosphoric acid at 2 levels	P_0	= 0 lb. $P_2 O_5$ to the acre.
	P_1	= 45 lb. ,,
Potash at 2 levels	K_0	= 0 lb. $K_2 O$ to the acre.
	K_1	= 60 lb. ,,

Manures are being applied currently at six different periods during the year. This practice is to continue until the plants close in, when the application period will be reduced to four. The following are the times of application:

Pre-blossom	=	Early March.
Post-blossom	=	10 days after blossom showers.
Pre-monsoon	=	End of May.
Break in the monsoon	=	August.
Post-monsoon	=	1. September-October.
		2. November.

(b) *Field Manurial trials on robusta coffee*

Manurial trials on the application of varying doses of nitrogen from 40 to 100 lb. to the acre with or without basal application of 30 lb. $P_2 O_5$ and 40 lb. $K_2 O$ to the acre on the same lines as those for arabica, have been laid out in five estates in predominantly S.W. monsoon areas of Malabar Wynaad (80 to 100

inches average rainfall per annum) and South Mysore (60 to 80 inches average rainfall per annum). Lay out and treatments are the same as for arabica, the only difference being the planting distance and the number of plants per plot:

Gross sub-plot of four main treatments	...	14×12	=168
Gross sub-plot of four sub-treatments	...	7× 6	= 42
Nett sub-plot of four sub-treatments	...	5× 4	= 20
Gross sub-plot of one replication	...	28×24	=672

Plots having uniform young robusta in bearing and planted 8 feet apart have been marked out. Pre-blossom and post-blossom manuring were carried out in March and May 1955. The experiments have been laid out on (1) North Carolina estate, (2) Krishna Estate, (3) Padripara Estate and (4) Chellote Estate in Malabar-Wynaad and (5) Sulgode Estate in Saklespur, South Mysore. Similar trials are contemplated at 3 more places in Mysore and two in South Coorg.

(*vi*) Studies on foliar feeding of plant nutrients

(a) *Exploratory trial on the effect of foliar applications of plant foods to coffee in relation to growth and yield*

Of recent years much attention has been paid to the feeding of plants through their leaves by spraying plant nutrients on to them. Success has been reported in the case of apples and peaches and it has been noticed that leaf nitrogen increases within twenty four hours, more crop is retained and the size and colour of fruits improve. In order to find out whether such an application of plant nutrients to coffee was possible, preliminary experiments were started on mature coffee at the Coffee Research Station, Balehonnur in April 1955. Foliar application of nitrogen and potassium were made on plants when the flowers had set and petals had dried and were about to fall off and subsequently at the end of a month. The details of the experiment are as follows:

Treatments:

A. N_1.	$6\frac{1}{3}$ oz. urea in 4 gall. of water to furnish 20 lb. nitrogen to the acre.
B. N_2.	$12\frac{2}{3}$ oz. urea in 4 gall. of water to furnish 40 lb. nitrogen to the acre.
C. K_1.	$4\frac{5}{6}$ oz. of muriate of potash (60 per cent K_2O) in 4 gall. of water to furnish 20 lb. potash to the acre.
D. K_2.	$9\frac{2}{3}$ oz. of Muriate of potash (60 per cent K_2O) in 4 gall. of water to furnish 40 lb. potash to the acre.
E. N_1 K_1.	$6\frac{1}{3}$ oz. urea and 4-5/6 oz. muriate of potash (60 per cent K_2O) in 4 gall. of water to furnish 20 lb. nitrogen and 20 lb., potash to the acre.
F. N_2 K_2.	$12\frac{2}{3}$ oz. urea and $9\frac{2}{3}$ oz. muriate of potash (60 per cent K_2O) in 4 gall. of water to furnish 40 lb. nitrogen and 40 lb. potash to the acre.
G. N_0 K_0.	4 gallons of plain water.
H. Control.	No treatment.

The plants receive the usual soil manurial application of 80 lb. N, 45 lb. P_2 O_5 and 40 lb. K_2 O to the acre.

Number of plants in each sub-plot = 3.
Guard rows—One on either side.
Replications—3.

Observations: The middle plant in each plot has been selected for observations. Two branches chosen at random on those plants have been tagged for observing the development and retention of berries which are recorded every month. The crop on the centre plant will be recorded.

(b) *Exploratory trial on the effect of essential minor and major mineral elements*

In December 1953, a report was received from an estate in North Coorg area (Madapur estate) that in one field in the estate, coffee plants in some blocks produced chlorotic leaves, which later turned apple-rose in colour, developed scorch spots and dropped. The size of the newly forming leaves also became smaller gradually. The plants slowly got debilitated and died. A spot inspection was carried out and leaf and soil samples analysed. The analysis showed that in general phosphorus was very deficient and this had limited also the intake of nitrogen and potash. In order to eliminate the possibilities of the occurrence of a minor element deficiency, foliar feeding and feeding through the soil of both minor and major mineral elements were started in October 1954. The scheme of the experiment is as follows:

Treatments

1.	N only,	as Urea spray to give 10 lb. nitrogen to the acre.
2.	N+P only,	as Urea+Ammonium phosphate spray to give 10 lb. nitrogen and $7\frac{1}{2}$ lb. P_2O_5 to the acre.
3.	N+K only,	as Urea+Muriate of potash spray to give 10 lb. nitrogen and 10 lb. K_2 O to the acre.
4.	N+P+K only,	as Urea+Ammonium phosphate+Muriate of potash spray to give 10 lb. nitrogen+$7\frac{1}{2}$ lb. phosphoric acid+10 lb. potash to the acre.
5.	P+K only,	as double super phosphate+Muriate of potash spray to give $7\frac{1}{2}$ lb. P_2 O_5 and 10 lb. K_2 O to the acre.
6.	Control.	No treatment.
7.	N+P+K spray	as under 4 above+soil application of Es-Min-El at $\frac{1}{2}$ lb. per plant in two divided doses.
8.	N+P+K spray	as under 4 above+spray Es-Min-El at 4 lb. per 100 gallons.
9.	N+P+K spray	as under 4 above+soil application of F.T.E. at 6 oz. per plant in two equal doses.
10.	N+P+K spray	as under 4 above+spray Cu. Zn. Mn. at 4 lb. in 100 gallons.
11.	N+P+K spray	as under 4 above+spray Tracel for coffee at 4 lb. in 100 gallons.
12.	N+P+K spray	as under 4 above+spray Nuiron at 3 lb. in 100 gallons.

All the applications excepting soil applications of Es-Min-El and F.T.E. to be repeated 4 times at fortnightly intervals, starting in September of each year.

Replications: 3 *Lay-out:* Randomized block.
No. of plants per plot: Nett 15. 5×3.
Common guard rows all around sub-plots.
Observations: (1) Visual observations on the disappearance of the deficiency symptoms and (2) Yield record from net plots.

Note

(1) Soil grade 'Es-Min-El' containing 9.87 per cent manganese, 3.81 per cent copper, 3.00 per cent iron, 2.42 per cent magnesium, 0.95 per cent calcium, 0.16 per cent boron and traces of chlorine supplied by M/s Tennessee Corporation, Atlanta, U.S.A.

(2) Spray grade 'Es-Min-El' and 'Cu. Zn. Mn.' containing 16 per cent copper, 16 per cent zinc, 16 per cent manganese supplied by M|s Tennessee Corporation, Altanta, U.S.A.

(3) Spray grade 'Tracel for coffee' containing 42 per cent zinc, 5 per cent copper, 2 per cent iron and 2 per cent manganese supplied by M/s Tennessee Corporation, Atlanta, U.S.A.

(4) Spray grade 'Nuiron'—nutritional iron compound—supplied by M/s Tennessee Corporation, U.S.A.

(5) Soil grade 'F.T.E.'—fritted trace elements—containing iron, copper, boron, zinc, manganese and molybdenum in a very slowly soluble form supplied by M/s Ferro Enamels Ltd., Wolverhampton, England.

(*vii*) Experiment on the response to manuring of coffee seedlings in the nursery

(a) *Preliminary trials with trace elements, Urea and ammonium phosphate*

This experiment was started in June 1954 and observations thereon were completed before planting the seedlings out into the field in Aug-Sep., 1954. Following were the treatments:

A. Urea+Es-Min-El.
B. Urea+F.T.E.
C. Urea only.
D. Ammonium phosphate+Es-Min-El.
E. Ammonium phosphate+F.T.E.

Results of the experiment are given in Table C. V.

The treatments have been significant. In the observation on the percentage extension of growth, Tr. A. is superior to Tr. B and Tr. D but not to Tr. C and Tr. E. Tr. C is significantly superior to Tr. D but not to Trs. E and B. Trs. E, B and D are not significantly superior to one another. In the observations on the percentage increase on the number of leaves, Tr. A has been significantly superior to Tr. D but not to Trs. C, B and E. Trs. C, B, E and D are not significantly superior to one another.

(b) *Comparative trails using Rapid-gro and other nitrogenous fertilizers*

This experiment was started in April 1955 on seedlings already established in nursery baskets. Following are the details:

Treatments 8

A.	Cowdung extract	4 baskets of fresh cowdung stirred up in 40 gallon of water, left overnight and 15 gallons of the supernatant liquid used for applying to seedlings.
B.	Ammonium sulphate	$12\frac{2}{3}$ oz. in 15 gallon of water.
C.	Rapid-gro*	$10\frac{2}{3}$ oz. in 15 gallon of water.
D.	Control	No treatment.
E.	Urea	$5\frac{1}{3}$ oz. in 15 gallon of water.
F.	Ammonium nitrate	$7\frac{1}{3}$ oz. in 15 gallon of water.
G.	Nitro phosphate	13 oz. in 15 gallon of water.
H.	Chilean nitrate.	1 lb. in 15 gallon of water.

In each case, 900 seedlings were treated with the quantities mentioned.

Plot size: 12 beds of basket seedlings in the nursery containing 7,200 seedlings, divided into 24 plots—half a bed containing 3 units of 100 seedlings each constituting a plot.

Replications: 3. *Lay-out:* Randomized block

Time and Method of application: 15 gallons of the above fertilizer solutions are applied to 900 seedlings under each treatment, once a week commencing from the last week of April till the time they are removed for planting. Solutions are watered on to the beds using a rose-can.

Observations: 1. Growth measurements at monthly intervals.
2. Visual observations on response to manuring.

Note: Rapid-gro* is a proprietory preparation marketed by Rapid-gro Corporation, Dansville, New York containing 23 per cent nitrogen, 21 per cent phosphoric acid and 17 per cent potash with vitamin B_1 and B_2 added.

(c) *Comparative trials using trace element preparations and Urea*

This experiment was started in April 1955 on seedlings already established in nursery baskets. Following are the details:

Treatments 8

A. Spray Es-Min-El (4 lb. in 100 gallons) in 1 per cent solution of urea sprayed.
B. Spray Tracel for Coffee (4 lb. in 100 gallons) ,,
C. Control (no treatment).
D. F.T.E. applied to soil (1 lb. per 400 sq. ft.) plus 1 per cent solution of urea sprayed.
E. Spray Cu. Zn. Mn. (4 lb. in 100 gallons) in 1 per cent solution of urea sprayed.
F. Soil Es-Min-El applied to soil (1 lb. per 400 sq. ft., of soil) plus 1 per cent urea solution sprayed.
G. Urea only—1 per cent solution urea sprayed.
H. Spray Nuiron (3 lb. in 100 gallons) in 1 per cent solution of urea sprayed.

In each case, 900 seedlings were treated with three gallons of the solutions mentioned above.

Plot size: 12 beds of baskets seedlings in the nursery containing 7,200 seedlings, divided into 24 plots—half a bed containing 3 units of 100 seedlings each constituting a plot.

Replications: 3. *Lay-out:* Randomized block.

Time and Method of application: Except in the case of soil applications of Es-Min-El and F.T.E., and Urea only, the respective materials in the required quantities are dispersed in 1 per cent urea solution and sprayed at the rate of 1 gallon per 300 seedlings. In the other cases plain 1 per cent urea solution is sprayed at the same rate and soil applications of Es-Min-El and F.T.E. done in the respective treatments. Applications of treatments are done at fortnightly intervals starting from the last week of April until the seedlings are removed for planting.

Observations: 1. Growth measurements at monthly intervals.
2. Visual observations on response to manuring.

B. Studies on growth and yield of coffee in relation to shade requirements—Hedge row system of planting

This experiment started in July 1953 was continued. The flower buds on the plants were rubbed out as they are still very young.

C. Studies on the use of alkalis and acids on the accelerated removal of mucilage from raw wet parchment

(i) Trials for finding a quick and easy method of paparing parchment

After detailed laboratory and field trials on a bulk scale, conditions were standardised for the use of alkalis for the rapid removal of mucilage from raw wet coffee parchment. It was found that 1 lb. of caustic soda dissolved in one gallon of water would remove the mucilage from 12 Imperial struck bushels of raw wet arabica parchment in 15-20 minutes and from 10-12 Imperial struck bushels of raw wet robusta parchment in about half an hour.

In the case of robusta where large quantities of *goondlus* (unpulped split fruits) get into the vat along with the parchment, it was found that washing was facilitated if half the quantity of caustic soda was used first, allowed to act; thereafter washing and draining the parchment and stamping thoroughly when the *goondlus* get skinned. A washing after this will help remove these skins. The balance of the caustic soda is then added and after action is over, the parchment is clean washed.

It has also been observed on a laboratory scale that it is possible to remove the mucilage more efficiently by using hot dilute sulphuric acid—at 10 per cent by volume (based on the volume of the raw parchment) of normal sulphuric acid at 90-95°C—in a very short time. The breakdown of the mucilage is complete in 3-4 minutes after raising the temperature of the mixed mass of raw parchment and acid.

(ii) Effect of rapid removal of mucilage on the final weight of coffee

Investigations on the loss of weight of coffee in relation to time taken for removal of mucilage from raw parchment were repeated. Following are the details:

Treatments: 3

A. Control (no treatment).

B. Hot sulphuric acid 10 per cent by volume (based on volume of raw parchment) of normal sulphuric acid.

C. Sodium hydroxide (caustic soda) 10 per cent solution to make 0.15 per cent by weight (based on weight of raw parchment).

Replications: 8.

1,000 gms. of fresh raw parchment prepared by hand pulping fruits of uniform size and ripening after removing floaters was used for each, and treatments imposed. Parchment lots were washed as soon as they were free of mucilage (determined by frequent tests). Four of the eight replications were dried in the sun to constant weight and the other four dried in a hot air oven between 60 to 80°C to constant weight. Parchment lots were hulled and clean coffee dried to constant weight as before. Results of the experiment are given in Table C. VI.

In the determination of percentage outturn of clean coffee over raw parchment, treatment B (Acid) which took 15 minutes to wash is significantly superior to both Trs. C (Caustic soda) which took 30 minutes and A (Control) which took 32 hours. Tr. C. (caustic soda) is only numerically superior to Tr. A (Control).

In the determination of loss in weight between dry parchment and clean coffee expressed as percentage of dry parchment, the treatments have not been significant. However Tr. B (Acid) has had the least loss in weight amongst the three. It would appear from the results of the past two years, that less loss in weight occurs when mucilage is removed rapidly from the raw parchment. Experiment will be repeated to confirm the results.

Laboratory

Work in the laboratory consisted mainly of analyses of soil, plant and manure samples sent by planters and those collected by the Department. Analyses of leaves and petioles collected from the New Manurial Series were continued. Analysis of soil profiles was continued.

(a) *Analysis of coffee leaves and petioles collected from the New Manurial Series*

Three more sets of samples of the second year's collection remained to be analysed. Results will be discussed later when these are completed.

(b) *Analysis of soil profiles collected from Hassan area*

Soil samples were collected from Hassan area in 1952 for study. The descriptions of the profiles were given in the Annual Report for 1951-52. Chemical and mechanical analyses of the soils have been completed. The analysis of the clay from these soils is in progress.

(c) *Analyses of soils from Karadibetta Estate, Saklespur (Mysore) area*

Seventy-two soil samples were collected from an area of 800 acres in 1953 from Karadibetta Estate for study. Chemical analyses of all these samples have been completed. Mechanical and clay analyses are in progress. Results will be discussed later.

(d) *Analyses of soil profiles from Shevaroys (Madras)*

Soil profiles were collected from Waverly and Glenpeak estates in the Shevaroy Hills (Madras State) for study, and analyses completed.

(e) *Seasonal variations in the availability of phosphoric acid and potash in coffee soils*

This study commenced in 1953-54 will come to a close with the completion of the analyses of eight more sets of soil which are in progress. Results will be discussed later.

The trend of the results obtained so far is that in plots supplied with phosphates, availability of phosphoric acid is always higher than in those that have not been so manured.

(f) *Analyses of green manures and cover crops*

Representative samples of two legumes growing wild near Goorghully estate, Saklespur (Mysore) and common *daisies* which are grown on slopes in coffee estates as soil binders were analysed. Results of the analyses are given in Table C. VII.

The data show the following:

Nitrogen	The common *daisies* have more nitrogen in their leaves and stems than the two legumes, *Desmodium labernifolium* and *Desmodium parviflorum.*
C/N Ratio	The C/N ratio is lowest in *daisies*, while it is the highest in *D. parviflorum.*
Phosphoric acid	The leaves of *daisies* contain more P_2O_5 than the leaves of *D. parviflorum* and *D. labernifolium.* The stems of *D. parviflorum* however contain more P_2O_5 than the others.
Potash	The potash content of the leaves of *daisies* is more than twice that of either of the two desmodiums. The stems of *daisies* contain more potash than stems of *D. parviflorum.*

It would appear that the common daisy is an excellent cover crop and would add to the fertility of the soil on being turned in. The quantity of green matter

that can be obtained and the capacity of the plant to withstand repeated cuttings will have to be studied.

(g) *Flow of water from the sub-soil drains of the New Manurial Series plots— (Analyses of leachates)*

During the season 1954-55, the sub-soil drains of the New Manurial series plots discharged the excess water that seeped through the soil on two occasions in July and August. In the first instance, discharge commenced in the afternoon of 17.7.1954 and continued till the evening of 19.7.1954. Samples of leachates were collected for analysis. The drains discharged again on 5.8.1954 and continued to do so till the 18th of the month. Samples were again collected on the first day of discharge and analysed. Table C. VIII gives the rate of flow from each drain and the quantities of nitrogen, phosphoric acid and potash lost on the first day of discharge on each occasion.

It is interesting to observe that as against the losses of phosphoric acid reported in the leachates studied in the previous year, only traces of phosphates could be detected this year. In 1953-54, the quantities of nitrogen, phosphoric acid and potash (*vide* annual Report for 1953-54 Table C. XIII) lost were 40.68 gms., 187.59 gms. and 134.96 gms. respectively on 5.8.1954 for a total rainfall of 81.83 inches recorded up to date. On 5.8.1953 for a total rainfall of 84.83 inches recorded up to date, 2176.6 gms. of nitrogen, traces of phosphoric acid and 1,961.5 gms of potash were lost in the leachates. The analyses of the leachates collected on 17.7.1954 show that 546.4 gms. of nitrogen, traces of phosphoric acid and 453.93 gms. of potash were lost on that day. Thus considerable losses of plant foods occur due to leaching in coffee soils. The total quantity of water that drained out of the soil is about 10 lakhs of gallons out of which about 6.25 lakhs gallons were drained within 4 days. The importance of proper drainage in coffee soils subject to heavy S.W. monsoon rains can well be understood from these figures.

(h) *Study of deficiency symptoms, leaf drop and berry drop*

The preliminary study of the probable cause of development of deficiency symptoms, leaf and berry drops was extended. Chemical analyses of affected materials were carried out:

Deficiency symptoms and leaf drop: Samples of leaves were collected for analysis from the field in which trace element feeding trials have been started (vide para vi (b) under Field experiments) at Madapur Estate, N. Coorg prior to application of treatments. Healthy leaves from healthy plants, apparently healthy leaves from affected plants, and diseased leaves from affected plants were analysed. It is seen that the healthy leaves from healthy plants show higher loss on ignition, total nitrogen, total phosphroic acid, total potash and lower ash content, insolubles (about 1/10 of that of diseased leaves), organic carbon and C/N ratio and total lime than the apparently healthy and diseased leaves.

Berry Drop: The dropped berries collected from Merthikan estate (N. Mysore) contained higher amounts of ash, total nitrogen, organic carbon, total phosphoric acid, total potash and total lime than the healthy berries and lower C/N ratio and total magnesia. The picture is changed in the samples collected in 1954 in which the dropped berries contain lower amounts of ash, organic carbon, total phosphoric acid, total potash and total magnesia with lower C/N ratio than the healthy berries and were higher in total nitrogen and total lime.

(i) *Advisory*

Analyses of soil samples from 6 estates in N. Mysore, one in S. Mysore, four in Coorg and two from Assam, were carried out. In all the cases, total phosphoric acid content has been either marginal or deficient; available phosphoric acid and potash are low. There appears to be a better reserve of potash

than phosphoric acid. The soils from Assam are particularly good in respect of total potash.

pH and lime requirement of soil samples sent from 2 estates in Mysore and 2 in Madras were determined.

The number of determinations carried out during the year were as follows:

1.	Moisture	489	12.	Total lime	282
2.	Loss on ignition	270	13.	Available $P_2 O_5$	342
3.	Insoluble residue	196	14.	Available $K_2 O$	404
4.	pH values	804	15.	Sesquioxides	178
5.	Lime requirements	102	16.	Iron oxide	89
6.	Organic carbon	566	17.	Total replacable bases	12
7.	Total nitrogen	534	18.	Mechanical analyses	516
8.	Nitrate nitrogen	11	19.	Clay analyses	36
9.	Total $P_2 O_5$	384	20.	Sieve analyses	4
10.	Total $K_2 O$	285	21.	Fat extraction	6
11.	Total magnesia	229		Total	5739

N. G. CHOKKANNA
Chemist

TABLE C.1. Studies on the essential requirements of plant foods N.P.K., for coffee in relation to improvement in yield—New manurial series

Yield record and percentage of floats in the harvest

Area of experimental plot: 76 cents *Layout:* Latin square *Treatments:* 5 *Replications:* 5
No. of plants per sub-plot: 5 × 8 = 40 (upto Jan. 55) *Spacing:* 5′ × 5′ (upto Jan. 55)
No. of plants for sub-plot: 5 × 4 = 20 (from Jan. 55) *Spacing:* along the rows = 10′
Shade = Artificial, bamboo slats on pandal along diagonal = 7′
Guard rows: One row all around the block Started in 1937
Annual rate of manuring: Nitrogen 60 lb., to the acre in three equal doses
Phosphoric acid 30 lb. to the acre in two equal doses
Potash 40 lb., to the acre in two equal doses

Average yield of ripe cherry in lb., and clean coffee in cwts. calculated to the acre percentage of floats in the harvest

Year and Particulars	TREATMENTS N A	NP B	NK C	NPK D	Control E	Standard error as percentage of general mean	Critical difference P=0.05	Significant or not	Conclusions
1941-53 See Table C-I of Annual Report for 1953-54									
1954 ripe cherry ...	1091	1082	1286	1553	1049	13.81	515	No	D C A B E
„ clean coffee ...	1.67	1.45	1.90	2.16	1.49	13.44	0.748	No	D C A E B
1955 ripe cherry ...	6672	7701	7040	7211	6398	25.66	1752	No	B D C A E
„ clean coffee ...	9.44	10.63	9.83	10.06	9.09	6.99	2.522	No	B D C A E
Average ripe cherry for 15 years	1190	1278	1300	1351	1020	6.46	244.2	Yes	D C B A E
Average clean coffee for 7 years	2.80	2.91	2.83	2.86	2.41	4.64	0.395	Yes	D B C A E
1954 Floats by volume ...	4.61	5.11	3.50	3.99	3.96	11.60	1.511	Yes	B A D E C
„ by weight ...	4.77	5.38	3.73	4.31	4.33	11.40	1.584	Yes	B A E D C
1955 Floats by volume ...	5.55	7.35	6.47	7.28	5.59	6.78	1.347	Yes	B D C E A
„ by weight ...	6.71	8.40	7.51	7.77	6.39	5.82	1.319	Yes	B D C A E

TABLE C. II. N.P.K. trials with varying levels of N.P.K.—fundamental manurial experiments in the pH cisterns

Yield record and percentage of floats in the harvest

Area of experimental plot: 5.0 cents *Layout:* Latin square *Treatments:* 6 *Replications:* 6
No. of plants per sub-plot: 1 *Spacing:* 7½′ *Started in:* 1950
Shade: Artificial-coir matting over pandal.
Annual rate of manuring:

A	20 lb.	Nitrogen,	30 lb.	Phosphoric acid,	40 lb.	Potash	to the acre
B	30	,,	30	,,	40	,,	,,
C	45	,,	30	,,	40	,,	,,
D	30	,,	45	,,	40	,,	,,
E	30	,,	45	,,	60	,,	,,
F	45	,,	67.5	,,	90	,,	,,

Year and Particulars	Average yield of ripe cherry and clean coffee in ozs. per plot—percentage of floats TREATMENTS A 20:30.40	B 30:30.40	C 45:30.40	D 30:45.40	E 30:45.60	F 45:67½.90	Standard error as %age of Genl. mean	Critical difference	Significant or not	Conclusions
1954 ripe cherry	23.08	10.75	12.59	13.29	10.46	22.71	31.17	14.84	No	A F D C B E
,, clean coffee	3.67	2.26	2.04	2.13	2.42	3.87	30.87	2.46	No	F A E B C D
1955 ripe cherry	33.29	30.49	21.46	15.93	18.33	25.77	21.09	15.06	Yes	A B F C E D
,, clean coffee	5.19	4.81	3.38	2.46	2.89	3.93	2.01	2.24	Yes	A B F C E D
Average ripe cherry for two years	28.18	21.85	17.02	13.64	16.15	24.24	18.50	11.02	Yes	A F B C E D
,, clean coffee ,,	4.43	3.53	2.72	2.30	2.66	3.87	19.66	1.78	Yes	A F B C E D
1955 percentage of floats by volume	18.51	20.49	15.40	23.14	16.99	14.28	13.14	7.84	Yes	D B A E C F
,, by weight	21.33	23.54	18.52	29.22	19.99	17.55	12.37	7.91	Yes	D B A E C F

TABLE C.III. Comparative trials on the influence of different forms of nitrogen on growth and yield of coffee-experiments in rubber Area

Yield Record

Area of experimental plots: 0.64 acre *Lay-out:* Randomized block *Treatments:* 3 *Replications:* 4
No. of plants per plot: Gross 4 × 16 = 64. *Nett* 2 × 14 = 28. *Spacing:* 6′
Shade: Natural mixed shade Started in September 1953.
Annual rate of manuring: A 60 lb. Nitrogen as urea in three equal doses, 30 lb. Phos. acid, 40 lb. potash to the acre
B 60 lb. ,, as calcium cyanamide ,, ,,
C 60 lb. ,, as ammonium sulphate nitrate ,, ,,

Year and Particulars	Average yield of ripe cherry in lb. calculated to the acre TREATMENTS A	B	C	Standard error as %age of general mean	Critical difference	Significant or not	Conclusions
1955 ripe cherry	1422	537	862	39.83	1295	No	$\overline{A\ C\ B}$
Average ripe cherry for two years	5559	3715	2762	25.71	3569	No	$\overline{A\ B\ C}$

TABLE C. IV. Studies on the Application of Nitrogen only in divided doses in relation to yield of coffee-Ossoor manurial experiments

Yield record and percentage of floats

Area of experimental plot: 0.8 acre *Lay-out:* Randomized block *Treatments:* 4 *Replications:* 6
No. of plants per plot: 8 × 5 = 40 *Spacing:* 6′
Shade: Natural mixed shade Started in June 1953
Annual rate of manuring: A 80 lb. nitrogen only to the acre in one single dose
B 80 lb. ,, in two equal doses of 40 lb. each
C 80 lb. ,, in three doses: 30 lb. 20 lb. and 30 lb.
D Control no treatment.

Year and Particulars	Average yield of ripe cherry in lb. and clean coffee in cwts. calculated to the acre—percentage of floats TREATMENTS A	B	C	D	Standard error as percentage of Genl. mean	Critical difference	Significant or not	Conclusions
1955 ripe cherry	2090	2335	2065	2160	16.25	176.9	No	$\overline{\text{B D A C}}$
1955 clean coffee	3.44	3.69	3.26	3.49	14.36	1.50	No	$\overline{\text{B D A C}}$
Average ripe cherry for 2 years	1885	2027	1838	2012	11.61	678.6	No	$\overline{\text{B D A C}}$
Average clean coffee	3.09	3.23	3.00	3.37	12.20	1.17	No	$\overline{\text{D B A C}}$
1955 floats by weight	5.99	5.99	5.46	6.07	7.79	1.38	No	$\overline{\text{D B A C}}$

TABLE C. V. Preliminary trials on the response to manuring of coffee seedlings in the nursery with trace-elements, Urea and Ammonium Phosphate

Observations on extension of growth and increase in number of leaves starting from 24-6-1954 to 23-8-1954

Lay-out: Randomized block *Treatments:* 5 *Replications:* 6

No. of seedlings per plot: 600 seedlings established in nursery baskets in units of 10 × 10 = 100

Rates of manuring:

A Urea+Es-Min-El—Urea at 2 lb. for 4200 seedlings+Soil Grade Es-Min-El at 1.lb. for 400 sq. ft. of soil
B Urea+FTE —Urea at „ +Soil Grade FTE „
C Urea only —Urea at 2 lb., for 4200 seedings
D Ammonium phosphate Ammo. Phos. (10 per cent N, 48 per cent P_2O_5) at 1 lb. for 4200 seedlings+Es-Min-El +Es-Min-El at 1 lb., for 400 sq. ft. of soil
E Ammonium phosphate „ at 1 lb. for 4200 seedlings+FTE +FTE at 1 lb. for 400 sq. ft. of soil

Manuring done at intervals of three weeks starting from 16-6-54 to 18-8-54—Four applications in all

Particulars	Average percentage increase in extension growth and increase in number of leaves in a period of nine weeks					Standard error as percentage of Genl. Mean	Critical difference	Significant or not	Conclusions
	A Urea+ Esminel	B Urea+ FTE	C Urea only	D Amophos+ Esminel	E Amophos+ FTE				
Percentage extension in growth based on initial height of seedlings ...	88.84	58.39	78.21	45.02	68.18	14.74	29.18	Yes	A C E B D
Percentage increase in number of leaves based on initial no. of leaves ...	65.02	55.45	63.27	44.79	50.95	11.52	18.92	Yes	A C B E D

TABLE C. VI. Investigation on the Loss of Weight of Coffee in relation to time taken for Removal of Muscilage—Effect of Rapid Removal of Mucilage on the final weight of Coffee—December 1954.

Percentage out-turn of clean coffee/raw parchment and percentage loss in weight of clean coffee/raw parchment

Treatments: 3—

A. Control—no treatment.

B. Hot sulphuric acid 10 per cent by volume (based on volume of raw parchment) of normal sulphuric acid mixed and heated on water bath.

C. Sodium hydroxide—10 per cent solution mixed to make 0.15 per cent by weight based on weight of raw parchment.

Replications: 8—Randomized.

Particulars	Time taken for removal of mucilage and percentage out-turn and loss in weight			Standard error as per cent of Gen. Mean	Critical dif. p = 0.05	Sig. or not	Conclusion
	Treatments						
	A	B	C				
Time taken for removal of mucilage	32 hrs.	15 mins.	30 Mins.				
Percentage out-turn of clean coffee/raw parchment ...	32.18	34.07	32.38	0.404	0.559	Yes	B C A
Percentage loss in weight of clean coffee/raw parchment	14.20	14.12	14.41	2.032	0.877	No	B C A

TABLE C. VII. Green Manures and Cover Crops—Nitrogen, Phosphoric Acid and Potash Content

(Analysis of oven dry materials)

Sample description	Loss on ignition	Total nitrogen	Organic Carbon	C/N Ratio	Total P_2O_5	Total potash
	%	%	%		%	%
1. *Desmodium labernifolium* leaves	90.79	3.276	39.07	11.92	3.219	1.841
2. *Desmodium parviflorum* leaves	91.61	1.456	36.78	25.25	5.028	1.957
3. *D. Parviflorum* stems	93.12	1.402	41.49	29.63	4.469	2.386
4. Common daisies leaves	89.54	3.529	37.24	10.55	5.425	4.109
5. Common daisies stems	93.80	3.332	35.81	10.76	3.175	2.926

TABLE C. VIII. Flow of water from the sub-soil drains of the new manurial series plot

Rates of discharge of drains (gallons)

Drain No.	Flow on 17-7-54	5-8-54	7-8-54	8-8-54	9-8-54	10-8-54	11-8-54	12-8-54	13-8-54	16-8-54	17-8-54	18-8-54	Total
1. ...	2,057	12,343	14,400	8,640	7.854	5,082	5,400	2,335	1,516	1,234	2,400	1,440	64.701
2. ...	10,165	43,200	43,200	43,200	21,600	18,000	21,600	10,800	4,320	5,760	14,400	8,640	2,44,885
3. ...	10,165	61,714	61,714	43,200	33,214	20,571	14,400	12,343	4,800	3,456	12,343	5,760	2,69,966
4. ...	1,028	43,200	43,200	4,320	21,600	15,429	17,280	7,845	3,456	443	7,854	3,456	1,56,771
5. ...	10,165	48,000	48,000	43,200	22,737	17,280	17,280	7,200	4,320	1,080	9,600	4,320	2,18,396
Total	33,580	2,10,514	2,10,514	1,42,560	1,07,005	76,362	75,960	40,523	18,412	11,973	46,597	23,616	9,54,719
Rain fall on date (in inches)	4.83	2.77	2.93	1.78	1.26	0.62	0.75	0.37	0.42	0.32	1.55	0.80	

Analysis of Leachates

	Leachate collected on 17-7-54 total rain fall to date 70.85 inches						Leachate collected on 5-8-54 total rainfall to date 84.83 inches					
	Nitrogen		Phos. Acid	Potash		pH	Nitrogen		Phos. Acid	Potash		pH
Drain No.	Gms. per Imp. gal	Gms. per day		Gms. per Imp. gal.	Gms. per day		Gms. per Imp. gal.	Gms. per day		Gms. per Imp. gal.	Gms. per day	
1. ...	0.0117	24.07	Traces	0.0143	29.42	5.7	0.0096	118.50	Traces	0.0125	154.30	5.8
2. ...	0.0139	148.70	Traces	0.0122	130.50	5.7	0.0096	414.80	Traces	0.0102	440.70	5.9
3. ...	0.0139	148.70	Traces	0.0129	138.00	5.7	0.0128	614.40	Traces	0.0113	542.40	5.9
4. ...	0.0117	12.02	Traces	0.0145	14.90	5.7	0.0144	444.50	Traces	0.0125	385.90	5.9
5. ...	0.0224	239.60	Traces	0.0150	160.50	5.8	0.0176	581.10	Traces	0.0132	438.30	6.0
Total	546.4 (1.2 lb.)				453.9 (1.0 lb.)		2176.7 (4.8 lb.)				1961.5 (4.3 lb.)	

IV. ENTOMOLOGY

Studies on the White Stem Borer and Green Bug on arabica, Shot-hole borer on robusta and Eelworm (parasitic on coffee) formed the main pre-occupation of the Section.

Particular attention was paid to the application of not only organic pesticides but also to the development and use of natural parasites against these insects.

A preliminary survey on the incidence, periodicity and seasonal intensity of pests at the Research Stations and in the several coffee zones was started with the co-operation of the Liaison staff and generous response of the planters to regularize effective control programmes.

Laboratory and field trials were directed to study the efficacy, residual toxicity of insecticides and the economics of such methods of control. Chlorinated hydrocarbons, organo-phosphorus compounds (including systemic insecticides), chlorinated camphene were used for these trials.

I. Field Experiments

1. *Insecticidal control of white stem borer of coffee-Xylotrechus quadripes Chev.*

Experiments started during 1953 and early part of 1954 were continued to study the relative efficacy of B.H.C. formulations, D.D.T., Dieldrin, Aldrin, Chlordane, Chlorinated camphene and Folidol E-605. In these experiments, different dilutions of insecticides in water were swabbed on to the main stems and thick primaries of coffee, once in April-May and twice in October-December, coinciding with the two borer flight seasons. Counts of healthy and infested (bored) plants were made at monthly intervals and the effect of treatments was evaluated.

Experiment 1

Object: To compare the relative efficacy of B.H.C. and its formulations, combinations of B.H.C. and D.D.T., and Folidol E-605 (emulsion and W.P.)

The experiment was started in April 1953.

Locality: Coffee Research Station, Balehonnur.

Lay-out: Randomised block. *Replications:* Four.

Plot size: 5 rows of 16 plants each average. (Vacancies are counted).

Total area under experiment: 2.91 acres.

Treatments: 9.

A. Control—No treatment.
B. Hexidol 950—1 per cent active concentrate.
C. Lindane W.P.—2 per cent active concentrate.
D. G-1250—1 per cent active concentrate.
E. Inexit W.P.—0.03 per cent active concentrate.
F. Inexit dust (20 per cent)—1:1 ash.
G. Folidol E. 605 con.—0.37 per cent active concentrate.
H. Folidol E. 605 W.P.—0.1 per cent active concentrate.
I. Gammexane emulsion con. 0.15 per cent active concentrate.

Details of infestation are furnished in Table *Ento-1*.

TABLE ENTO: I. Experiments on the Insecticidal Control of White Stem Borer

Comparative efficacy of various insecticidal formulations in the control of White stem borer in coffee (Xylotrechus quadripes Chev.)

Treatments	1953-54			1954-55		
	No. of healthy plants (initial)	No. of borer infested plants removed	Percentage of borer infestation	No. of healthy plants (initial)	No. of borer infested plants removed	Percentage of borer infestation
A Control	278	17	6.06	259	8	3.1
B Hexidole 950-1 per cent ac.*	295	11	3.90	290	8	2.8
C Lindane WP-2 per cent ac.	288	22	7.50	289	6	2.1
D G. 1250-1 per cent ac.	288	12	4.24	279	5	1.8
E Inexit WP-O. 03 per cent ac.	277	8	3.02	279	7	2.5
F Inexit dust (20 per cent) 1:1 ash.	287	17	5.79	270	17	6.3
G Folidol E.605 con. 0.37 per cent ac.	310	14	4.42	302	20	6.6
H Folidol E.605 W.P. 0.11 per cent ac	262	24	8.93	241	22	9.1
I Gammexane emulsion con. 0.15 per cent ac.	318	13	4.05	312	6	1.9

* ac. Active concentrate.

It is seen from the above Table that G. 1250 and B.H.C. irrespective of the nature of the formulation give effective control of the stem borer. It should however be added that the continued application of B.H.C. formulations in the overall estate over six seasons had definitely reduced infestation with the result that even the control plots in the 1954-55 series showed considerable protection.

Separate tests are being concurrently conducted on 'cup quality' of coffee so treated.

Experiment 2

Object: To compare the efficacy of B.H.C. 50 per cent, W.P., Chlordane and Toxophene for controlling the Coffee Stem Borer.

In the previous experiment, B.H.C. 50 per cent W.P., was found to be effective and economic for use at 1 per cent strength against the Coffee Stem borer. A trial was undertaken to compare the efficacy of B.H.C. 1 per cent with Chlordane (a chlorinated hydrocarbon) and Toxophene (chlorinated camphene) used at 0.09 per cent and 0.1 per cent (active concentrations) respectively. The experiment was started in October 1953.

Locality: Coffee Research Station, Balehonnur.

Lay-out: Randomised block. *Replications:* Four.

Plot size: 2 rows of 40 plants each average. (Vacancies are counted).

Area under experiment: 1.19 acres.

Treatments: 4

A. Control—No treatment.
B. B.H.C. 50 per cent W.P.—1 per cent active concentration.
C. Chlordane—0.09 per cent active concentration.
D. Toxophene—0.1 per cent active concentration.

TABLE ENTO: II

Treatments	1953-54 No. of healthy plants (initial)	1953-54 No. of borer infested plants removed	1953-54 Percentage of borer infection	1954-55 No. of healthy plants (initial)	1954-55 No. of borer infested plants removed	1954-55 Percentage of borer infection
A Control (no treatment)	318	2	0.40	318	9	2.8
B B.H.C. 50 per cent W.P. 1 per cent ac.	303	0	0.00	298	3	1.0
C Chlordane 0.09 per cent ac.	314	3	0.97	301	5	1.7
D Toxophene 0.1 per cent ac.	299	4	1.37	293	7	2.4

It is again observed that B.H.C. formulations give more effective control than the other pesticides under test.

Experiment 3

Earlier experiments had indicated that B.H.C. formulations were effective against Coffee stem borer. Recently two new insecticides (formulations of Aldrin and Dieldrin—cyclopentadiane derivatives) were stated to have great toxic effect on variety of insects of the class of bugs, beetles and similar insects. Experiments were therefore started to test the efficacy of these formulations agianst that of B.H.C. It was also stated that the new insecticides have a longer lasting effect.

Aldrex 2 and Dieldrex 15 each at 0.5 per cent active concentration were applied twice—once in each of the two borer flight seasons—and B.H.C. 50 per cent W.P. thrice during the year (once in the April-May and twice in the Oct.-Dec., borer flight seasons). The experiment was started in May 1954.

Locality: Coffee Research Station, Balehonnur.
Lay-out: Randomised block. *Replications:* Four.
Plot size: 4 rows of 10 plants each. (Vacancies were counted).

TABLE ENTO: III

Treatments	1954-55 No. of healthy plants (initial)	1954-55 No. of borer infested plants removed	1954-55 Percentage infection
A Aldrin 0.5 per cent	158	10	6.3
B B.H.C. 50 per cent W.P. 1 per cent	160	6	3.8
C Control (no treatment)	160	7	4.4
D Dieldrin 0.5 per cent	159	6	3.8

Further work is in progress.

Experiment 4

Object: To determine the relative residual toxicity of different concentrations of Dieldrex 15, Aldrex 2, combinations of B.H.C. and D. D.T. and B.H.C. alone.

Exploratory trials were undertaken to compare the effective periods of toxicity of insecticides mentioned in the earlier trial. D.D.T. was also tested in combination with B.H.C. formulations as it was known to have a longer residual effect in other instances. Recent work had also shown that additions of secondary products may catalyse the efficiency of the primary products.

(*a*) Cut stems of coffee were swabbed with the insecticidal formulations and kept under glass.

(*b*) Insecticides were swabbed on to stems of selected plants in the field and the stems jacketted with wire gauze.

Commencing from the 17th day after swabbing, live beetles of White stem borer (*Xylotrechus quadripes Chev.*) were released at weekly intervals on to the treated stems in both instances. These releases were made till the 75th day from start of experiment.

Observations were made on mortality and period of activity inclusive of ovipositing. It was found that the treatment was lethal over a period of 33 days in the case of B.H.C. (1 per cent) with or without D.D.T., and Dieldrin formulations at 0.125 and 0.25 per cent active concentration. At higher concentrations of Dieldrin formulation (0.5 per cent), the lethal effect lasted as long as 53 days in the laboratory and 51 days in the field. This is interesting in view of the possibility of this latter period covering a major portion of the flight season. Furthermore it was observed in the laboratory that no ovipositing was noted even as late as the 75th day.

Further extended trials are in progress.

Experiment 5

Trials with systemic insecticides

Of recent years considerable evidence is to be had of effective control of pest infestation by the use of a new group of insecticides—systemic insecticides. Insects such as bugs, aphids and other insects feeding on treated plants are reported to be killed by the toxic effect. The insecticides are absorbed by the plants and translocated and possibly stored in the cells of the plant. It is also known that the concentration of these insecticides is of an infinitely small order.

Exploratory trials were therefore made to inject the following proprietary insecticides at active concentrations varying from 0.1 to 0.5 per cent and study the resulting effects:

Sytam, Pestox, Tetrax, Systox.

The treated plants were split open after an interval of eight days from the commencement of the treatment and examined to observe the effect of the insecticides on the larvae. At this stage, the insecticides did not seem to have any effect. Further examination at longer periods are in progress. Higher concentrations of these insecticides are also being injected to study the effect not only as a larvicide but also as a direct pesticide.

II. Green Bug on Coffee

(a) *Comparative trials on the use of organic pesticides against green bug*

Experiment 6

Object: An exploratory trial to compare the relative efficacy of Ekatox '20' W.P., Ekatox '20' liquid, H.E.T.P., and H.E.T.P., in combination with B.H.C. for controlling Green bug.

The experiment was started in Feb. 1955 at the Coffee Research Station, Balehonnur. The treatments were as follows.

A.	Control.	
B.	Ekatox '20' liquid	0.025 per cent
C.	,,	0.05 per cent
D.	Ekatox '20' W.P.	0.025 per cent
E.	,,	0.05 per cent
F.	,,	0.10 per cent
G.	H.E.T.P.	0.125 per cent
H.	H.E.T.P.+B.H.C. 50 per cent W.P.	0.125+1 per cent

Four plants were taken for each of the treatments. An estimate of the population of green bug was made before spraying (initial) and after a period of 8 days and again 6 weeks from spraying. Leaves and twigs were sampled out at random and the population of bugs in a unit area (of a circle $1\frac{1}{2}$ cm. diameter on leaves and $1\frac{1}{2}$ cm., leangth on the twig) was determined. The data are represented in the following Table.

TABLE ENTO: IV

	Treatment	No. of healthy green bugs in 4 samples before treatment	No. of green bugs alive 1 week after treatment	Percentage mortality	No. of green bugs 6 weeks after spraying
A	Control (no treatment)	276	263	4.7	303
B	Ekatox '20' liquid 0.025 per cent (1.1 lb., in 440 gallons)	190	5	97.4	26
C	Ekatox '20' liquid 0.05 per cent (2.2 lb., in 440 gallons)	267	6	97.8	28
D	Ekatox '20' W.P. 0.025 per cent (1.1 lb., in 440 gallons)	204	78	61.8	82
E	Ekatox '20' W.P. 0.05 per cent (2.2 lb., in 440 gallons)	264	50	81.1	54
F	Ekatox '20' W.P. 0.1 per cent (4.4 lb., in 440 gallons)	262	17	93.5	7
G	H.E.T.P. 0.125 per cent (5.5 lb., in 440 gallons)	324	20	93.8	30
H	H.E.T.P. 0.125 per cent + B.H.C. 50 per cent W.P. 1 per cent (0.5 lb., 8 lb., in 40 gallons)	263	26	90.1	7

Ekatox '20' W.P. at 0.1 per cent active concentration, H.E.T.P. at 0.125 per cent active concentration by itself alone or with B.H.C. gave more than 90 per cent mortality in the course of 8 days and a further reduction over as long a period as 5 weeks. The lower concentrations of Ekatox '20' W.P. were less effective both in the initial kill and effective duration of toxicity.

(b) *Studies on the incidence and use of Entomogenous fungii in the control of green bug*

Studies on the biological control of green bug by the entomogenous fungii—*Cephalosporium lecanii* and *Empusa lecanii*—were continued during the year. It was found that the natural peak incidence of the fungi ranged from July to Jan. of each year and continued to decline thereafter till June. Studies on the use of cultures of these fungii as controlling agents during the dry periods are in progress.

III. Shot-hole Borer on Robusta Coffee

Studies on the incidence of the pest was started in August 1954. One per cent of plants in an area of 10 acres (which worked to 60 plants) were selected at random and counts of the infested twigs were made. Five of such twigs per plant were split open to observe the developmental stages of the insect. Observations were made at 20 days' interval till Feb. and monthly thereafter to cover

the entire life period of the insect. The following Table summarises the infestation:

TABLE ENTO: V

Sl. No.	Date of observation	Total no. of infested twigs in 60 plants	Sl. No.	Date of observation	Total no. of infested twigs in 60 plants
1.	18 August 1954	416	8.	18 January 1955	422
2.	13 September 1954	490	9.	8 February 1955	306
3.	7 October 1954	414	10.	10 March 1955	165
4.	27 October 1954	483	11.	24 April 1955	80
5.	17 November 1954	307	12.	26 May 1955	9
6.	7 December 1954	452	13.	27 June 1955	49
7.	27 December 1954	442			

The infestation was at a peak from August to November coinciding with the monsoons. A short undulating recession was noticed during the winter months followed by increasing reduction of infestation in the dry periods from January to May. All the developmental stages of the pest were noticed throughout the year, indicating that the insect has overlapping broods. These observations are being continued to formulate necessary measures of control.

(a) *Trials with organic pesticides*

Experiment 7

Object: An exploratory trial to find out the efficacy of insecticides for controlling shot hole borer as compared to pruning:

Shot hole borer in recent years has been noticed as a severe pest on robusta in coffee growing areas. The method of control at present is the cultural practice of tracing the infested twigs, pruning and burning such pruned twigs away from site. This involves much care, time and labour in locating and removing the borer infested twigs. Trials were therefore started to examine the use of insecticides found effective earlier for the White Stem Borer (*Xylotrechus quadripes* Chev.) of arabica. The experiment was started in August 1954.

Locality: Coffee Research Station, Balehonnur.
Lay-out: Randomised block. *Replications:* 6 (each with 2 plants)

Treatments

A. G. 1250 (B.H.C. 25 per cent + D.D.T. 25 per cent) at 2 per cent
B. B.H.C. 50 per cent W.P. at 1 per cent
C. Control. No treatment
D. D.D.T. 50 per cent W.P. at 1 per cent
E. Pruning.
F. 0.2 per cent D.D.T. + 1 per cent Euphytan Summer oil.
G. 0.2 per cent B.H.C. + 1 per cent Euphytan Summer oil.

Two sprayings of the insecticides were given—one on 23rd August 1954 and another on 23rd September 1954. Corresponding to these spraying, pruning of the infested twigs was done in the treatment under 'Pruning'.

Before the imposition of treatments, counts of shot-hole borer infested twigs were taken. Two infested twigs from each plant were split open at each step of observation and the stages of development were noted. Subsequent observations were made at intervals of 20 days (to cover the life period of the insect) throughout the year.

The results are represented in Graph 1. It is seen that at all periods of infestation, G. 1250 and B.H.C. formulations have given maximum control and specially noticeable at the peak period. The work is in progress.

(b) *Exploratory trials with the use of organophosphorus compounds with and without Bordeaux for shot-hole borer control*

It is known that shot-hole borer developes on ambrosia fungus. Studies were therefore undertaken to find out the effect of Bordeaux against this fungus, by the use of Bordeaux by itself alone and in combination with the pesticides to evolve if possible, a technique of indirect control. The following treatments were given:

(1) Ekatox '20' W.P.—0.2 per cent.
(2) Folidol E-605—0.055 per cent.
(3) Ekatox '20' W.P.—0.2 per cent *plus* Bordeaux 2-2-40.
(4) Folidol E-605—0.055 per cent *plus* Bordeaux 2-2-40.
(5) H.E.T.P. 0.125 per cent.
(6) Bordeaux 2-2-40.
(7) Control.

Results: Ekatox '20' W.P. and Folidol E-605 with or without Bordeaux were better than Bordeaux or H.E.T.P. which were next in order. All these were effective against only adults. There was however a recurrence of infestation, possibly developing from immature stages of the insect which do not seem to have been affected by the treatments mentioned above.

IV. Control of Eelworm

Of recent years, increasing evidence is obtained of the occurrence of parasitic eelworms in isolated patches of many parts of coffee areas especially North Coorg, North and West Mysore and South Madras. In the earlier years when small patches were located, certain soil sterilization and amendment programmes were undertaken on the lines then current in other parts of the world especially Dutch East Indies (Indonesia) particularly on coffee soils. Attempts were also made to plant such areas with robusta in place of the existing arabica. These did not seem to have proved successful on account of the enormous cost of labour and the special techniques involved in the earlier case and the possible unsuitability of robusta in those particular micro climatic zones.

Recently with the advent of newer types of insecticides inclusive of selective nemacides and the emergence of certain soil amendment compositions of fairly low cost, a considerable amount of work has been done in effecting an appreciable control of such nematodes. Exploratory trials were therefore started, one on a field scale and the other in pot culture on a private estate in North Coorg during December 1953 and continued to February 1955. The experiments were definitely restricted to an established eelworm tract to avoid importation of eelworm infested soil to other zones.

Experiment 8

(i) *Object:* To compare the relative efficacy of insecticidal and soil amendment treatments for controlling parasitic eelworms on coffee:

The experiment was laid out in a randomized block with six replications and has the following treatments imposed upon them exclusive of control.

1. *Ekatox* '20' *liquid*—0.1 per cent strength of pure parathion at the rate of 10 gallons per plot.
2. *Hanane* capsules placed at the foot of each plant (2 gms. per plant).
3. *Lime* at the rate of 37 lb., per plot (2 tons per acre) and forked to a depth of 9".
4. *Calcium cyanamide* to give 20 lb., Nitrogen to the acre in pre-bloossom period, 1 cwt., *Sulphur* to the acre to be applied at 6 inch depth in pre-monsoon followed by application of *urea* to give 80 lb., Nitrogen to the acre in post monsoon.

Soil samples at depths of 0-9", 9-18", 18-27' and 27-36" were taken from each of the replications once a month during the first 6 months of the trial, thereafter once a fortnight. These were examined for eelworm population. Treatments were repeated once a month except in the case of the soil amendments.

(ii) Simultaneously with the field trials detailed above, experiments in pot-culture using Ekatox, Sytam, B.F.P.O., Folidol E 605 (Organophosphorus insecticides), Shell D.D. and Cynogas (fumigant insecticides) were started.

The pots were filled with soil infested with eelworms and each treatment was applied to 40 of these pots.

The insecticides were applied once a month. Soil samples were taken as in the earlier case once a fortnight for eelworm counts and one plant at random was pulled out once a month from each treatment to examine the root scrapings for nematode infestation.

Results: (i) In the field trials, indications were that (a) Ekatox was effective in arresting the increase of eelworms provided periodic applications of the insecticide was made and (b) soil amendment treatments (Calcium cyanamide, Sulphur, Urea) decreased the populaton of eelworms.

(ii) In the pot trials it was again noted that Ekatox at repeated applications arrested the increase in population of eelworms.

In the light of the indication that a single application of soil amendments helped in not only arresting increase of nematode pupulation but actually showed decreases of such infestation, the experiment was redesigned to critically examine the possibilities of practical use of these treatments on a field scale. The experiment was started in March 1955 in the same estate:

Locality: Coovercolly Estate, Coorg.

Lay-out: Randomised. *Replications:* 6.

Treatments: 3 *Plot size:* 3 × 3 = 9 plants

A. Control—Normal doses of manure N.P.K. 60.30.40.

B. Soil amendment—by application of calcium cyanamide at 20 lb., nitrogen to the acre in pre-blossom, 1 cwt., sulphur to the acre to be applied at 6" depth in pre-monsoon followed by applicatoin of urea at 80 lb., nitrogen to the acre in post-monsoon.

C. Soil amendment—Same as treatment 'B' except sulphur.

Phosphoric acid and potash would be given proportionately in treatments B and C.

We are grateful to W/Cdr., J. H. Sprott, O.B.E., D.F.C., for providing facilities to conduct these trials at Coovercolly, North Coorg.

Laboratory Studies

(1) *Studies on the possible parasites and predators on common pests of coffee*

(a) *Aspergillus tamari* Kita.

Host: Coffee Stem Borer—*Xylotrechus quadripes* Chev.

In the previous year, during the course of examination of the borer infested stems, a beetle was observed infested with some fungus. The fungus mycelia were at the pleural regions. The beetle was kept under observation. When the spores developed from the infested beetle, preliminary trials were undertaken to determine the pathogenicity of the fungus on the live beetles. These trials were promising. Further trials were undertaken to confirm the previous observations. In the laboratory trials, indications were that the fungus killed the beetles in 3-6 days whereas the beetles under normal (control) conditions lived for a little over 10 days. These trials were extended for test under field conditions. *Aspergillus spores* suspensed in nutrient medium were sprayed on

to the borer infested stems. After an interval of 3 weeks from spraying, the stems were split open and examined. Out of the 2 pupae collected from the sprayed stems, one was found dead which on further examination revealed the presence of Aspergillus infection. (*Aspergillus tamari* Kita). Further trials are being undertaken during the coming year (1955-56).

(b) *Beauveria bassiana*

This fungus known to kill other insects by mycocis was tried on the adults and larvae of the coffee stem borer. It was noticed that the fungus killed the larvae. Further studies are in progress.

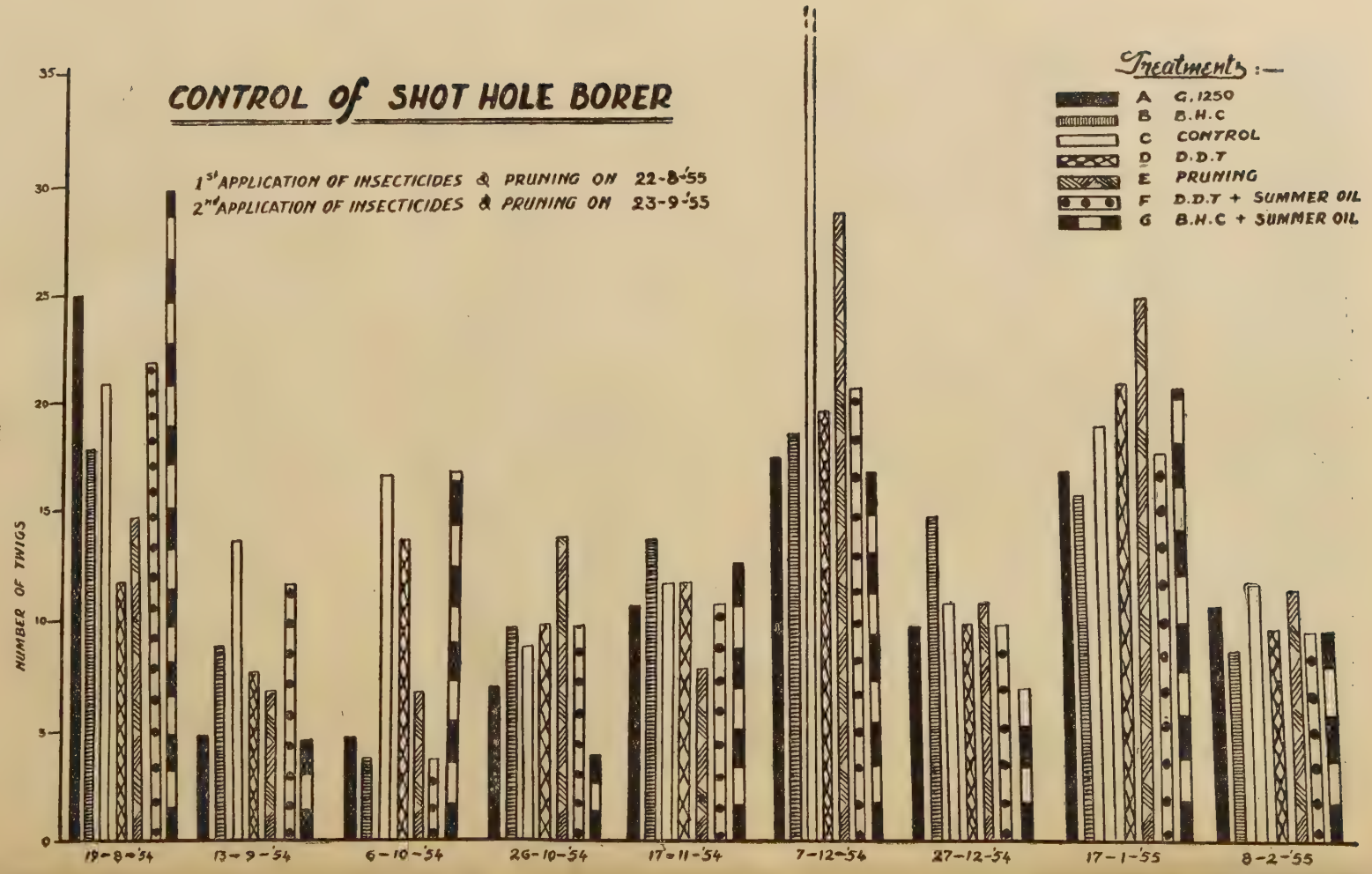
(2) *Observations on some new insects*

Borer infested stems of coffee, teak, *Albizzia stipulata* (Putta bage) received from some private estates and also collected from the Coffee Research Station, Balehonnur were kept for the emergence of the adults. The following list summarizes the several insects so found:

	Insect	*Host plant*	*Remarks*
1.	*Collyris sp.* Cicindelidae (Coleoptera)	Coffee	It is observed to be a predator
2.	*Ceratina sp.* Hymenoptera	Coffee (Robusta) Albizzia stipulata	It bores tunnels mostly on dried twigs
3.	*Chlorophorus sp.* Cerambycidae (Coleoptera)	Teak	
4.	*Chlorophorus* 14 *maculata* Cerambycidae (Coleoptera)	Teak	
5.	*Tillus notatuss suturalis* Cerambycidae (Coleoptera)	Teak	
6.	*Demonax sp.* Cerambycidae (Coleoptera)	Coffee	
7.	Weavil larva (Baridinae 2) Gen. and sp. indet.	Albizzia stipulata	

Our thanks are due to the Forest Entomologist, Forest Research Institute, Dehra Dun and to the Director, Commonwealth Institute of Entomology, London for kind identification of the above insects.

S. A. Raja Rao
Entomologist


CONTROL of SHOT HOLE BORER
1st APPLICATION OF INSECTICIDES & PRUNING ON 22-8-'55
2nd APPLICATION OF INSECTICIDES & PRUNING ON 23-9-'55
Treatments :—
A G.1250
B B.H.C
C CONTROL
D D.D.T
E PRUNING
F D.D.T + SUMMER OIL
G B.H.C + SUMMER OIL
NUMBER OF TWIGS
0
5
10
15
20
25
30
35
19-8-'54
13-9-'54
6-10-'54
26-10-'54
17-11-'54
7-12-'54
27-12-'54
17-1-'55
8-2-'55

V. MYCOLOGY

Studies on leaf disease of coffee caused by *Hemileia vastatrix*, Black rot caused by *Pellicularia koleroga*, nursery diseases caused by *Cercospora coffeicola*, *Colletotrichum coffeanum* and *Rhizoctonia solani* and their control formed the main work of this section. Field trials to evaluate the efficacy of some of the proprietory fungicides (both protective and eradicant types) available, as compared with the standard Bordeaux mixture 2:2:40 spray as well as the use of detergents, adheisives, spreaders and wetters along with Bordeaux mixture for controlling leaf disease were carried out. Examination of various diseased coffee specimens to find out the causative organisms and their isolation in culture were also attempted.

Field Trials

1. *Spray experiment to compare the efficacy of different strengths of Bordeaux mixture*

Object: To find if strengths of Bordeaux mixture lower than 2:2:40 could give efficient control of coffee leaf disease.

This experiment was started in June 1951 and being continued. Post-monsoon spray application was given in September 1954 and pre-monsoon spray in April 1955. Leaf counts were taken in September 1954 and February 1955. Yield for 1954 was recorded.

Locality: Crawford area, Coffee Research Station, Balehonnur.
Year: 1954-1955.
Variety: Kents

The following three treatments:

A.	Bordeaux mixture	2:2:40
B	,,	$1\frac{1}{2}$:$1\frac{1}{2}$:40
C	,,	1:1:40

were applied—replicated 4 times in a randomized lay-out. The details of yield and leaf counts are summarized in Table MYC. I.

Yield records for 1954-55 show that there is no significant difference between the various strengths of Bordeaux tried, but however numerically, strength 2:2:40 has given higher yields as compared with $1\frac{1}{2}$:$1\frac{1}{2}$:40 and 1:1:40. Leaf counts taken in September 1954 do not show any significant difference but in February 1955 leaf counts, 2:2:40 strength shows significant superiority over 1:1:40 strength.

2. *Spray experiment to compare the efficacy of proprietory copper fungicides with that of Bordeaux mixture*

Object: To find out the efficacy of these proprietory copper fungicides in controlling leaf disease as compared with Bordeaux mixture.

The experiment was started in May 1953. Post-monsoon spray was given in September 1954 and Pre-monsoon spray in May 1955. Leaf counts were taken in September 1954 and February 1955. Yield for 1954 was recorded.

Locality: 'O and M' blocks, Coffee Research Station, Balehonnur
Year: 1954-1955.
Variety: Coorgs.

The following four treatments:

A	Wetcol-15	3 lb., in 40 gallons of water
B	Fungi-copper Geigy	1 lb., in 40 gallons of water
C	Cupravit	1 lb., in 40 gallons of water
D	Bordeaux mixture	2:2:40.

were applied—replicated 4 times in a randomized lay-out. The details of yield and leaf counts are summarised in Table MYC. II.

Yield records for 1954-55 do not show any significant difference between treatments. Numerically, treatment C (Cupravit) has given highest yields 3835 lb./acre followed by A (Wetcol-15) 3723 lb./acre and D (Bordeaux mixture) 3081 lb./acre. Fungi-copper Geigy has given lowest yields 1780 lb/acre. Leaf counts in September 1954 show that treatment C is significantly superior to B. Leaf counts in February 1955 show that treatment A is significantly superior to C. Both in yields and leaf counts, treatment B has shown low figures.

3. *Spray experiment to find out the efficacy of adding detergents, adheisives, wetters and spreaders to Bordeaux mixture*

Object: To compare the efficacy of adding detergents, adheisives, wetters and spreaders to Bordeaux as against plain Bordeaux in controlling leaf disease.

The experiment was started in May 1954. Post-monsoon spraying was given in September 1954 and pre-monsoon spraying in May 1955. Leaf counts were recorded in September 1954 and February 1955. Yield for 1954 was recorded.

Locality: Q Block, Coffee Research Station, Balehonnur.

Year: 1954-1955.

The following eight treatments:

A	Bordeaux mixture 2:2:40	
B	,,	*plus* 1½ oz., Teepol in 40 gallons.
C	,,	*plus* 6 oz., Stanvac detergent in 40 gallons.
D	,,	*plus* 7½ oz., Corvus oil in 40 gallons.
E	,,	*plus* 10 oz., Arkotine in 40 gallons.
F	,,	*plus* 1½ oz., Lissapol N. in 40 gallons.
G	,,	*plus* 1 oz., Agral L.N. in 40 gallons.
H	,,	*plus* 1.6 lb., of Adhesive Y.F. 3198 in 40 gallons.

were applied—replicated 4 times in a randomised lay-out. The details of yield and leaf counts are summarized in Table MYC.III.

Yield recorded in 1954-55 is basic. Leaf counts in September 1954 show that treatments C and B are significantly superior to treatments D, G and H, and that treatment F and E are superior to G and H. Leaf counts in February 1955 show that treatments E and D are significantly superior to G and H and that F is superior to H. Both in September 1954 and February 1955 leaf counts, treatment H has given poor results.

4. *Spray experiments to compare the efficacy of proprietory fungicides with Bordeaux*

Object: To find out the efficacy of proprietory fungicides in controlling leaf disease as compared with Bordeaux mixture.

The experiment was started in September 1954. Post-monsoon spraying was given in September 1954 and pre-monsoon spraying in May 1955. Leaf counts were taken in September 1954 and February 1955. Yield for 1954 was recorded.

Locality: Shegode Estate, Balehonnur.
Year: 1954-55.

The following six treatments:

A	Bordeaux mixture 2:2:40.	
B	Perenox	1 lb. in 40 gallons of water.
C	Blitox	1 lb. in 40 gallons of water.
D	Shell copper fungicade	1 lb. in 40 gallons of water.
E	Parry's Bye-product	2½:2½:40
F	Dithane Z-78	10 oz., in 40 gallons of water.

were applied—replicated 4 times in a randomised lay-out. The details of initial yield and leaf counts are summarised in Table MYC. IV.

Yield recorded in 1954-55 is basic. Leaf counts in February 1954 has shown that treatment A (Bordeaux mixture) is significantly superior to treatment B (Perenox). Between treatment A and treatments, C, D, E and F, there is no significant difference observed.

5. *Spray experiment to compare Mercurised copper oxychloride with Bordeaux mixture*

Object: To find out the efficacy of mercurised copper oxychloride as compared with Bordeaux mixture in controlling leaf disease.

The experiment was started in September 1954. Post-monsoon spraying was given in September 1954 and pre-monsoon spraying in May 1955. Leaf counts were taken in September 1954 and February 1955. Yield for 1954 was recorded.

Locality: L1 Block, Coffee Research Station, Balehonnur.
Year: 1954-1955.

The following six treatments:

A	Bordeaux mixture 2:2:40.	
B	Mercurised copper oxychloride	2 lb., in 100 gallons of water.
C	,,	3 lb. ,,
D	,,	4 lb. ,,
E	,,	5 lb. ,,
F	Copper Sandoz 53	1 lb. in 40 gallons of water.

were applied—replicated 6 times in a randomised lay-out. The details of initial yield and leaf counts are summarised in Table MYC. V. Yield recorded in 1954-55 is basic. Leaf counts taken in February 1955 show that treatment B (Mercurised copper oxychloride 2 lb., in 100 gallons of water) is superior to treatment A (Bordeaux mixture).

Observations made on plants sprayed with different concentrations of mercurised copper oxychloride at the main Station and from a similar experiment being conducted at a private estate nearby using Mercurised copper oxychloride at 25½ ozs., and 36 ozs., in 40 gallons of water and Phenyl Mercury acetate at 6½ oz., 8 oz., and 10 oz., in 40 gallons Bordeaux mixture, indicate the following:

(1) No phytotoxic symptoms were noticed on sprayed plants.
(2) No appreciable eradicant effects by direct killing and suppression of sporulation on old infected spots for any considerable time due to the mercurial sprays was noticed.
(3) Fresh infections were also noticeable freely.

6. *Comparison of Tuzet fungicide with Bordeaux mixture*

Object: To find out the efficacy of Tuzet fungicide in controlling leaf disease as compared with Bordeaux mixture, an exploratory trial was laid out.

Premonsoon spray application was given in May 1955.

Locality: Crawford area, Coffee Research Station, Balehonnur.

Lay-out: The different concentrations of this fungicide tried are alternated with the control plots i.e., Bordeaux sprayed—non replicated.

Plot size: 1 row of 16 plants.

Treatments

A	Bordeaux mixture	2:2:40
B	Tuzet fungicide	0.2 per cent.
C	Bordeaux mixture	2:2:40.
D	Tuzet fungicide	0.1 per cent.
E	Bordeaux mixture	2:2:40.
F	Tuzet fungicide	0.05 per cent.

Preliminary observations made in June seem to indicate that this fungicide causes some phytotoxic symptoms on the coffee, namely, chlorosis of the leaf area between veins and veinlets. This is conspicuous in 0.2 per cent and less in 0.1 per cent. In 0.05 per cent, it is practically absent. Observations on leaf counts to assess the efficacy of this fungicide in controlling leaf disease is to be taken in September 1955.

7. *Trials with Low Volume Spray Nozzles*

Object: To find out whether by using low volume spray nozzles any considerable economy in spray mixture can be effected without imparing the efficacy of leaf disease control.

Locality: Crawford area, Coffee Research Station, Balehonnur.

Treatments

A Drake and Fletcher Broadway Mistifier nozzle No. 'O' jet.
B Low Volume 'Tee jet' No. 8UO4.
C „ No. 65006.

This exploratory trial was started in June 1955. Bordeaux mixture was sprayed using a D.S.P. Sprayer with a single lance, hose length 300 ft., and pressure maintained more or less constant at 225 lb., at the pump. The time taken for giving a complete coverage for one coffee bush of average size and the volume of mixture required for it using different jets are given in following table.

Type of jet used	*Time required for spraying one bush in seconds*	*Volume of mixture for spraying one bush in C.Cs.*	*Calculated Vol. of mixture and time required for spraying one acre*
Drake and Fletcher Broadway nozzle No. 'O' jet	21.7	1190	334 gals. 7 hrs. 14 min.
Low Volume Tee Jet No. 8U04	48.3	1290	341 gals. 16 hrs.
Low Volume Tee Jet No. 65006	65.0	753	198 gal. 21 hrs. 4 min.

It is seen from the above table that

1. Use of Low volume Tee jet No. 8U04 does not seem advisable since it consumes more spray mixture and takes more time to spray a unit area as compared with the usual types of nozzles.

2. Using Low volume Tee jet No. 65006, a considerable economy in spray mixture is effected. In the Low volume jet, the spray droplets are very much smaller and this prevents the various tiny droplets from coalescing together and running down and thus prevents wastage which normally occur with the usual type of nozzles.
3. To ensure a proper coverage of the under-surface of the coffee leaves to afford protection from leaf disease, it is seen that more time is taken using the low volume nozzle as compared with the high volume high pressure nozzles.

Using low volume nozzles, it is very essential to see that Bordeaux mixture is prepared properly to ensure as fine a suspension as possible. Lime should be of good quality and it should be strained through a fine muslin cloth ; otherwise there is possibility of clogging of the fine strainer provided in these nozzles.

8. *Relation of nutritional conditions to incidence of leaf disease*

Object: To find out the possibility of nitrogenous fertilizers alone, predisposing the coffee bush to leaf disease by inducing sappy sacculant vegetative growth.

Observations on leaf disease incidence were recorded in two adjacent blocks, one receiving complete manure mixture and the other receiving nitrogenous manure only.

The results are given in the following table:

Manurial treatment	Percentage incidence of leaf disease	
	September 1954	February 1955
N.P.K.	51.9	32.9
N	56.3	33.8

The slight increase in the percentage incidence of disease in plot receiving nitrogenous fertilizer only as compared with the plot receiving the complete N.P.K. is not marked. Further observations are being continued.

9. *Observational studies on the life history and control of Black rot (Pellicularia koleroga) of coffee*

Object: To find out the mode of oversummering of the Black rot fungus and its control in the field.

This was started in 'R' block, Coffee Research Station, Balehonnur, in August 1954 when the disease was coming to a close as the monsoon was fading away. Observations made in June 1955 indicate the following:

1. Plants infected in the previous year and where the diseased material has not been handled and burnt showed infection in June 1955 observation also.
2. Healthy uninfected plants near about infected plants (observed in August 1954) remained free from infection in June 1955 whereas the plants showing infection in previous season showed infection this season also.
3. Infected material kept tied to healthy uninfected plants in August 1954 did not transmit the disease till June 1955.
4. Infected material kept at the bottom of healthy plants both in contact with the collar region and away from it did not transmit the disease till June 1955.
5. Infected plants in which the diseased material was handled and burnt and sprayed with Bordeaux mixture in August 1954 showed only

a very slight infection in June 1955 as compared with infected plants where no handling and spraying were done (Heavy infection was noticed on these plants).

No conclusions can be drawn from the above as to how exactly the black rot fungus tides over the unfavourable summer months. However, it is seen that the bushes having infection in previous season are the ones which exhibit the disease first during current season. These probably serve as nuclei for further spread to neighbouring plants. Handling of diseased material and burning them and spraying the bushes with Bordeaux mixture seem to have reduced the intensity of infection though not completely checked it in one season as compared with untreated infected plants.

10. *Germination trials using seed dressing materials*

Object: To find out the efficacy of certain mercurial and non-mercurial seed dressing materials in checking pre-emergence and post-emergence damping off in nursery seedlings.

Locality: Nursery, Coffee Research Station, Balehonnur.

Lay-out: Randomized.

Replications: Four.

Plot size: 100 seeds, per plot.

Treatments

A	Agrosan GN	2 oz., per 40 lb., of seed.
B	,,	1 oz., ,,
C	TB4452-b	2 oz., ,,
D	Leytosan	2 oz., ,,
E	Leytosol B	1 in 150 parts (for soil sterilization)
F	Control	Not treated.

The seed lots (S.333) were treated separately with the different chemicals and stored for 2 days prior to sowing. The germination beds were prepared and each plot demarcated by a broad plank pushed deep into the bed so that there is no chance of the chemicals getting mixed up in the adjacent plots. Seeds were sown on 2-2-1955. Observations taken on 7-3-1955, 14-3-1955, 26-3-1955 and 12-4-1955 on the germination percentages, incidence of damping off and the effect if any on the growth rate and performance of the seedlings are shown in the following tables.

Average percentage germination at different intervals after sowing

Treatments	Observations taken on			
	7-3-1955	14-3-1955	26-3-1955	12-4-1955
A	8.00	28.00	64.25	80.00
B	16.50	24.75	78.75	90.75
C	9.75	27.75	64.00	87.25
D	9.50	25.00	63.25	87.00
E	1.50	7.50	24.75	80.00
F	11.25	29.00	61.25	87.25

Treatment B (Agrosan GN—1 oz., in 40 lb.) has given highest germination followed by C, D and F. E has given lowest germination. The difference in germination percentages between E and other treatments is narrowed as more and more time passes.

Average length of shoot and root and number of lateral roots formed

Treatments	*Average length of shoot*	*Average length of tap root*	*Average number of side roots*
A	2.4	2.1	29.8
B	2.4	2.2	34.3
C	2.4	2.3	31.8
D	2.5	2.2	30.0
E	2.7	2.0	17.0
F	2.4	2.7	33.5

No appreciable difference is seen either in the length of shoot or root in the various treatments. However, in treatment E, there seems to have been a slight inhibition of side root development.

LABORATORY STUDIES

1. Studies on physiologic specialization in Hemileia vastrix

Repeated attempts to isolate the 4 strains of the fungus using the Indicator plants S.353, S.288, S.286 and Coorg coffees and Uredospores taken from these for cross inoculations did not give consistent results and hence so far the strains could not be isolated.

2. Studies on the life history of Hemileia vastrix

(*a*) *Germination of Uredospores and factors influencing*

The following observations were made:

1. Uredospores started germinating in 1½ to 2 hours, provided the necessary favourable conditions for germination were given.
2. Strong direct light inhibited germination. Best germination was observed in complete darkness.
3. Submerging of spores in water reduced the percentage of germination, whereas dusting of spores on to the water film gave highest germination.
4. A high percentage of germination occurred in neutral hydrogen ion concentration, but towards the acid and alkali ranges, it reduced.
5. Spores taken from very old pustules gave lesser germination as compared to those taken from fresh active pustules.

Most of the above observations on factors affecting germination of Uredospores confirm the earlier observations of W.W. Mayne.

(b) *Period of viability*

Detached infected leaves kept under laboratory and field conditions were found to lose germination capacity of Uredospores in a month's time during the dry weather. As such, the fallen infected material possibly does not play an important role in the carry-over of the disease for next season. Initiation of the disease is hence likely through the few infected leaves remaining attached to the plants from previous season.

3. Comparative study of the Black rot fungus from Coffee and its alternate hosts

Pellicularia koleroga from coffee has been isolated in culture. Attempts to reproduce the disease under artificial laboratory conditions did not succeed. Search for any alternate hosts of the fungus amongst the shade trees at Coffee Research Station, Balehonnur, did not show any infected during the South West Monsoon of 1954. A similar disease was observed on rose bushes and mint (Mentha piperata) in June 1955. This fungus belonging to the genus *Pellicularia* is being isolated.

4. Investigations on the association of some fungi found growing on leaf disease rust pustules

Two fungi found growing on rust pustules have been isolated in culture. They have been identified as *Cephalosporium* and *Cercospora* Sp.

5. Culture work

The following fungi were isolated in culture from various diseased coffee specimens. The cultural characteristics of these fungi and artificial inoculation trials using these isolates are in progress. A list of fungi isolated is given below.

Rhizoctonia solani	from collar rot affected seedlings.
Fusarium Sp.	,,
Colletotrichum coffeanum	from brown blight affected coffee seedlings.
Cercospora coffeicola	from nursery seedlings and young plants in clearings dying.
Ozonium Sp.	from young plants wilting in clearing.
Fusarium Sp.	,,
An unidentified fungus	,,
Colletotrichum Sp.	from Die back affected twigs.
Pellicularia koleroga	from Black rot affected leaves.
Fomes noxius	Root rot affected coffee roots.
Rosellinia arcuata	,,
Cephalesporium lecanii	from infected green bugs.
Cephalosporium on leaf disease pustules	from infected leaf disease spots
	,,
Cercospora Sp.	,,
Aspergillus tamari Kita	from infected Stem borer beetle.

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Mycologist

TABLE MYC. I. Results of Strengths of Bordeaux Mixture Experiment (Crawford area, Coffee Research Station, Balehonnur)

	Treatments	Effective percentage of leaf survival		Yield of ripe cherry in lb/acre				Calculate clean coffee in cwts/acre
		Sept. 1954	Feb. 1955	1951-52	1952-53	1953-54	1954-55	1953-55
A	Bordeaux mixture 2:2:40	41.52	59.75	3467	444	3562	6247	9.50
B	,, 1½:1½:40	45.00	57.10	3083	447	4969	6029	9.51
C	,, 1:1:40	34.54	49.05	3041	411	4485	6011	9.22
	General Mean	40.35	55.30				6095	
	Significant or not	No	Yes				No	
	Critical difference	10.47	9.14				2828	
	S.E.M. percentage	7.95	5.07				2041	
	Conclusion	B A C	Ā B C				Ā B C	

TABLE MYC. II. Results of Spray Experiment to compare efficacy of proprietary fungicides with Bordeaux Mixture

('O' and 'M' Blocks, Coffee Research Station, Balehonnur)

Symbol	Treatments	Effective percentage of leaf survival		Yield of ripe cherry in lb/acre		Calculated yield of clean coffee in cwts/acre
		Sept. 54	Feb. 55	1953-54	1954-55	
A	Wetcol 15	44.18	53.01	4102	3723	5.40
B	Fungi copper Geigy	39.05	48.20	3636	1780	2.56
C	Cupravit	51.55	43.50	3202	3835	5.40
D	Bordeaux mixture	44.91	52.25	4203	3081	4.29
	General Mean	44.92	49.26		3104	
	Significant or not	Yes	Yes		No	
	Critical difference	10.54	8.98		2364	
	S.E.M. percentage	7.61	5.92		23.81	
	Conclusions	C D A B	A D B C		C A D B	

TABLE MYC. III. Results of spray experiment to find out the efficacy of adding various detergents, wetters and spreaders to Bordeaux mixture

('Q' Block, Coffee Research Station, Balehonnur)

Symbol	Treatments		Effective percentage of leaf survival		Yield of ripe cherry in lb. per acre 1954-55	Calculated clean coffee in cwts. per acre, 1954-55
			Sept. 1954	Feb. 1955		
A	Bordeaux mixture 2:2:40		49.01	50.80	5799	9.2
B	,,	+1½ oz., Teepol in 40 gallons	53.94	48.95	7142	10.96
C	,,	+6 oz., Stanvac detergent in 40 gallons	54.13	53.80	6731	10.82
D	,,	+7½ oz., Corvus oil ,,	41.82	57.20	6404	9.89
E	,,	+10 oz., Arkotine ,,	51.54	57.50	6887	11.05
F	,,	+1½ oz., Lissapol N ,,	51.68	54.70	5901	9.54
G	,,	+1 oz., Agral L.N. ,,	39.96	47.75	6236	10.00
H	,,	+1.6 lb., Adheisive Y.F. 3198 ,,	38.78	45.10		
		General Mean ...	47.60	51.98		
		Significant or not ...	Yes	Yes		
		Critical difference ...	10.59	9.09		
		S.E.M. percentage ...	7.69	6.04		
		Conclusions	CBFEADGH	EDFCABGH		

TABLE MYC. IV. Results of spray experiment to compare proprietary fungicides with Bordeaux mixture (Snigode estate, Balehonnur)

Symbol	Treatments	Effective percentage of leaf survival		Yield of ripe cherry in lb/acre	Calculated clean coffee in cwt. per
		Sept. 1954	Feb. 1955	1954-55	acre 1954-55
A	Bordeaux mixture 2:2:40	67.95	55.45	2270	3.70
B	Perenox	74.20	39.45	2287	3.60
C	Blitox	70.00	45.20	1614	2.52
D	Shell copper fungicide	81.33	45.90	1387	2.16
E	Parry's Bye-product	76.46	51.40	2068	3.40
F	Dithane Z-78	77.13	45.40	1850	3.02
	General mean		47.13		
	Significant or not		Yes		
	Critical difference		14.56		
	S.E.M. percentage		10.47		
	Conclusions		A E D F C B		

TABLE MYC. V. Results of Spray experiment to compare mercurised copper Oxychloride with Bordeaux mixture (L 1 Block, Coffee Research Station, Balehonnur)

Symbol	Treatments	Effective percentage of leaf survival		Yield of ripe cherry in lb/acre	Calculated clean coffee in cwt/acre
		Sept. 1954	Feb. 1955	1954-55	1954-55
A	Bordeaux mixture 2:2:40	58.33	41.30	3827	6.15
B	Mercurised copper oxychloride 2 lb., in 100 gal. water	75.64	64.40	5351	9.06
C	„ 3 lb., „	65.67	56.70	4736	7.48
D	„ 4 lb., „	74.48	48.35	4278	6.49
E	„ 5 lb., „	69.74	59.85	4430	7.13
F	Copper Sandoz-53 1lb., in 40 gallons of water	60.66	46.70	7601	9.72
	General Mean		52.88		
	Significant or not		Yes		
	Critical difference		19.09		
	S.E.M. percentage		12.24		
	Conclusions		B E C D F A		

COFFEE RESEARCH SUB-STATION

Chethalli (Coorg)

All the experiments were conducted in consultation and with the active co-operation of the technical officers at the Coffee Research Station, Balehonnur.

1. Botany

Observations on plant material obtained from Balehonnur and from Ghattedhulla were continued. These selections were mainly intended to study their suitability to the area and for future multiplication of such selected material—

A. *Arabica coffee*

(i) Non-replicated trials—1949 plantings:

Selections	*No. of plants put in*	*No. that failed and those removed as off types*
S. 795	215	34
S. 645	238	24
S. 288	2,900	501
S. 531 × Kents	76	9
S. 26 × Kents	56	15

(ii) **Replicated trials—1949 plantings**

During 1949, a replicated trial with varieties S.795, S.645, S.288 and S.446 was laid down in a latin square. Each plot contained 12×8 plants.

No spraying was done, but the plots were manured for the year 1953-54 and 1954-55 in the usual manner with a mixture at 60 lb. N, 30 lb. P_2O_5 and 40 lb. K_2O to the acre.

The summary of the yield of crop is given below:

Particulars	Yield per acre Ripe cherry in lb. and clean coffee in cwt								
	A	B	C	D			Sig. or not	Crit. Diff.	Conclusions
	S. 446	S. 795	S. 645	S. 288	Mean	SEM%			
1952									
Ripe cherry	875	255	193	133	364	23.48	Yes	191	A,BCD
Clean coffee	1.30	0.38	0.29	0.20	0.54			0.43	
1953									
Ripe Cherry	3746	1897	1366	808	1954	16.22	Yes	1095	A,BCD
Clean coffee	5.57	2.82	2.03	1.20	2.91			1.63	
1954									
Ripe cherry	1541	3402	2478	1498	2230	14.18	Yes	1096	B,CAD
Clean coffee	2.29	5.06	3.69	2.23	3.32			1.63	
1955									
Ripe cherry	6939	9043	4865	4403	6063		Yes		B,ACD
Clean coffee	8.84	13.46	7.24	6.55	9.02				

S.795 is free from leaf disease and has given an even yield. S.446 is susceptible to leaf disease and has been better than others in only 2 of the 4 years.

2. Chemistry

(i) *Catalyzation of plant nutrients*

This experiment originally laid down in 1950 in collaboration with the Bio-Chemist, Indian Institute of Science, Bangalore, to study the effect of certain catalysts on the availability of plant foods, was continued. The last period when the catalyst chemicals were applied was in December 1951. Only yeild data are maintained. All cultural operations including application of general manures were conducted in the usual manner. A statement giving the yield of coffee in 1955, under different catalyst application is given below:

	Treatment	*Ripe cherry in lb. per acre*	*Clean coffee in cwt. per acre*	*S.E.M. per cent*	*Sig. or not*	*Crit. diff.*	*Conclusions*
A	28 lb. Ferrous sulphate	8196	12.20		No		EDCAB
B	20 lb. Potassium permanganate	8052	11.98				
C	40 lb. Catalyst	8454	12.58				
D	80 lb. „	8598	12.79				
E	Control	8832	13.14				
	Mean	8426	12.54				

As in the earlier years there has been no significant response to any of the treatments. The work is being continued in order to introduce some amendments to the treatments.

(ii) *Studies on the manurial requirements of coffee in relation to improvement of yield*

(a) An experiment on the influence of varying levels of nitrogen, phosphate and potash either singly or in different combinations started in 1952 was continued. 4 levels of nitrogen from 0 to 120 lb., 2 levels of P_2O_5 at 0 and 45 lb. and 2 levels of K_2O at 0 and 60 lb. to the acre are under trial.

A first blossom on the plants was rubbed out during the year. It was interesting to observe that plants that received nitrogen are retaining more old leaves than those that have not.

(b) An exploratory trial on the application of varying doses of nitrogen with a constant dose of phosphate and potash was started in 1954, as a check on the regional field trials described in the Chemist's report.

Gross plants per plot 10×7
Nett. 8×5
Nitrogen at 4 levels N_1=40 lb. N_2=60 lb.
N_3=80 lb. N_4=100 lb. to the acre.
Phosphoric acid at one level at 30 lb. to the acre.
Potash at one level at 40 lb. to the acre.

In block I, the manures are applied in 2 doses, pre-blossom and post-monsoon and in block II, nitrogen is applied in 3 doses, pre-blossom, post-blossom (pre-monsoon) and post-monsoon, while phosphoric acid and potash are divided into 2 doses and applied pre-blossom and post-monsoon.

The plan of the experiment is given below:

BLOCK I

N_1	N_2PK	N_3	N_2P
N_2P	N_2	N_2PK	N_4

BLOCK II

N_4	N_2P	N_2PK	N_2
N_2PK	N_1	N_3	N_2P

The manure was applied first time this year (1954-55) and an initial basic crop was picked.

(c) *Field manurial trials*—As an extension of this experiment, a replicated trial on the lines of the field trials in selected zones was also laid down in September 1954.

Treatments

A Nitrogen at 40 lb. to the acre per annum.
B ,, 60 lb. ,,
C ,, 80 lb. ,,
D ,, 100 lb. ,,

N_1—2 equal doses pre-monsoon and post-monsoon.
N_2—3 equal doses pre-blossom (20th February—5th March).
pre-monsoon (2nd week of May).
Post-monsoon (20th September—5th October).

NP—N in 3 equal doses.
NPK—N in 3 equal doses.
P, K are applied in 2 equal doses pre-blossom and post-monsoon.
Size of plots: Gross 10×7=70 plants.
Nett. 8×5=40 plants.

PLAN

N_2P $N_{40}P_{30}$	N_2 N_{40}	N_1 N_{60}	N_2P $N_{60}P_{30}$
A		B	
N_1 N_{40}	N_2PK $N_{40}P_{30}K_{40}$	N_2PK $N_{60}P_{30}K_{40}$	N_2 N_{60}

N_2PK $N_{80}P_{30}K_{40}$	N_2 N_{80}	N_2P $N_{100}P_{30}$	N_2 N_{100}	N_2PK $N_{60}P_{30}K_{40}$	N_1 N_{60}
C		D		B	
N_1 N_{80}	N_2P $N_{80}P_{30}$	N_1 N_{100}	N_2PK $N_{100}P_{30}K_{40}$	N_2 N_{60}	N_2P $N_{60}P_{30}$

NP $N_{100}P_{30}$	N_1 N_{100}	N_2 N_{80}	NPK $N_{80}P_{30}K_{40}$	N_2 N_{40}	NPK $N_{40}P_{30}K_{40}$
D		C		A	
N_2 N_{100}	N_2PK $N_{100}P_{30}K_{40}$	N_2P $N_{80}P_{30}$	N_1 N_{80}	N_2P $N_{40}P_{30}$	N_1 N_{40}

N_2 N_{80}	N_2P $N_{80}P_{30}$	N_2 N_{60}	N_2PK $N_{60}P_{30}K_{40}$	N_1 N_{100}	N_2P $N_{100}P_{30}$
C		B		D	
N_2PK $N_{80}P_{30}K_{40}$	N_1 N_{80}	N_2P $N_{60}P_{30}$	N_1 N_{60}	N_2PK $N_{100}P_{30}K_{40}$	N_2 N_{100}
N_1 N_{40}	N_1 N_{80}				
A					
N_2PK $N_{40}P_{30}K_{40}$	N N_{40}				

(d) An experiment on the manurial requirements of robusta coffee for yield with varying levels of N, P, K either singly or in combination was started in September 1954. Details are given in the Chemist's report.

3. Plant Protection Mycology

(a) *Comparative trials of copper fungicides against Bordeaux*

This experiment started in the latter part of 1953 was continued. The following treatments were under test:

A Wetcol (prepared Bordeaux proprietary), 4 lb. in 40 gallons of water.
B Bordeaux 2-2-40.
C Control (no treatment).
D Cupravit (Bayer's product) 1 lb. in 40 gallons of water.
E Yellow Cuprocide (Amrithlal and Co.) 10 oz. in 40 gallons of water.

Replications: 5.

Size of each plot: 1 row of coffee trees with 15 trees in each row and one common guard row between any adjacent treatment.

Note: The strength of the Bordeaux substitutes has been adjusted to the same copper content as that in Bordeaux 2-2-40.
Leaf counts are made both pre-monsoon and post-monsoon.

The yield of crop and leaf counts for 1954-55 are furnished in the following table:

Treatment	E.P.L.S. Sept. 54	E.P.L.S. Feb. 55	Yield/acre Ripe cherry in lb.	Yield/acre Clean Coffee cwt.	SEM %	Sig. or not	Crit. diff.	Conclusions
A	13.3	44.85	3264	4.86	8.52	Yes	694 lb., or	
B	14.9	51.93	4112	6.12			1.03 cwt.	B,ACDE
C	11.9	49.3	3312	4.93	when compared against the rest as a whole			
D	12.9	48.44	3024	4.50				
E	14.6	47.93	3504	5.21	Average Q C D E—3276 lb.			
Mean			3440	5.12	or 4.88 cwt. per acre			

Bordeaux is superior to other copper fungicides.

(b) *Comparison of mercurised copper oxychloride with Bordeaux*

A new experiment to study the phytotoxicity of mercurised copper oxychloride was started during May 1955. The details are as follows:

Treatments

A Mercurised copper oxychloride 2 lb. in 100 gallons of water.
B ,, 3 lb. ,,
C ,, 4 lb. ,,
D ,, 6 lb. ,,
E ,, 8 lb. ,,
F Bordeaux mixture 2-2-40 strength.

Replications: 4.

Size of each plot: 1 row of coffee trees with 10 trees in each row and one common guard row between any adjacent treatment.

The first spraying was given during the second week of May. So far no phytotoxic effect has been noticed.

4. Plant protection—Entomology

Experiments on the use of insecticides for control of coffee stem borer (Xylotrechus quadripes Chev.)

(a) The exploratory trial on the comparative efficiency of B.H.C. formulations and organo-phosphorus compounds for controlling borer started early in May 1953 was continued. Details of the experiment are as follows:

Treatments

A 70 per cent chlordane—8 oz. of Intox 8 in 40 gallons of water.
B B.H.C.—50 per cent B.H.C. W.P. 8 lb. in 40 gallons of water.
C Control—no treatment.
D 40 per cent Toxaphene—10 lb. in 40 gallons of water.
E 46.6 per cent Folidol—$3\frac{1}{3}$ oz. in 40 gallons of water.

Each plot carried 4 rows, but the control plots carry 8 rows with 2 guard rows on either sides. Vacancies are being counted.

Replications: 8.

Comparative efficiency of B.H.C. formulations and organophosphorus compounds for the control of Coffee Stem Borer

	Treatments				
	A	*B*	*C*	*D*	*E*
Plants 3 years and above at the commencement of 1953/54	771	772	797	765	838
Total plants uprooted during 1953/54	101	109	192	105	132
Plants 3 years and above at the commencement of the year 1954/55	728	704	591	732	745
Total number of plants uprooted during the year 1954/55	37	35	92	36	35

All formulations have given effective control of infestation. It is however to be observed that borer incidence was definitely less in 1954-55 in comparison with the previous seasons.

(b) Concurrently with the experiment at Balehonnur, a field trial with Dieldrin against B.H.C. formulations was started in 1953, with the following treatments:

A 1 per cent B.H.C. 8 lb. in 40 gallons of water—4 times a year, October, November, April and May.
B 1 per cent B.H.C. 8 lb. in 40 gallons of water—2 times a year, October and April.
C Control. No treatment.
D Dieldrin 0.125 per cent (2 lb. of 25 per cent W.P. in 40 gallons water) 2 times a year, October and April.

There were 10 replications with 4 rows of plants containing not less than 50 plants in each replication. There are 8 rows in the untreated plots. 2 guard rows are maintained. Vacancies are being counted.

Results

	Treatments			
	A	B	C	D
Plants 3 years and above at the commencement of 1953 1954	942	802	896	836
Total plants uprooted in 1953/54	53	64	89	82
Plants 3 years and above at the commencement of 1954/55	900	752	819	805
Total number of plants uprooted during the year 1954/55	16	19	55	13

Two applications of Dieldrin are as good as 4 applications of Gammexane.

(c) A comparative trial to test the efficacy of B.H.C. formulations, organophosphorus compounds and Dieldrin was started in April 1955 with the following treatments:

A Chlordane—8 oz. in 40 gallons of water, 3 times a year, October, November and April.
B B.H.C. 50 per cent W.P., 8 lb. in 40 gallons of water—3 times a year October, November and April.
C Control—No treatment.
D Dieldrin 0.25 per cent—1 gallon in 72 gallons of water—2 times a year, October and April.
E Dieldrin 0.125 per cent—1 gallon in 144 gallons water—2 times a year, October and April.
F B.H.C. 50 per cent W.P.—8 lb. in 40 gallons of water 4 times a year, October, November, April and May.

Replications: 4. *Plot size:* 20×4=80 plants.
Total area under the experiment: 1.6 acres.

Control of eelworm

An exploratory trial on a private estate for control of eelworm started in 1953 was continued in co-operation with the Entomologist. Indications were obtained that the use of soil amendments inclusive of an application of adequate quantities of manures was more effective in minimizing the ravages of this nematode than fumigants and certain proprietary chemicals like Hanane and Ekatox 20. The experiment was therefore revised to test the influence of the following treatments of soil amendment:

A Control—Normal doses of manures—60N: 30P: 40K.
B Soil amendment—by application of Calcium cyanamide at 20 lb. N per acre in pre-blossom, 1 cwt. sulphur per acre to be applied at 6″ depth in pre-monsoon followed by an application of Urea at 80 lb. N per acre in post-monsoon.
C Soil amendment treatment as in 'B' but without Sulphur.

Lay-out: Randomised. *Replications* 6.
Size of plot: 3 × 3 = 9 plants.

5. Agronomy

(1) *Cultivation experiments:* To find out the most suitable method of soil management in old coffee, a replicated lay out on a latin square has been set. Incidentally preliminary yield records were taken from individual plots in order to standardise them prior to carrying out the treatments.

Locality: Chethalli (Coorg) *Lay-out:* 6 × 6 latin square.
Variants: 6. *Variety:* Arabica (Coorg)
Age: About 20 years.
Area of each plot: Gross 16 × 10 plants. Nett 14 × 8 plants.
Shade: Natural.

Treatments

A Trenching $1\frac{1}{2}'$ deep.
B Trenching $\frac{3}{4}'$ deep.
C Renovation pitting.
D Light digging.
E Heavy digging.
F Control.

The treatments were imposed first during October-November of 1953. The yield figures do not show statistical difference between treatments. Visual observations however show that young plants exhibited improvement in all treated plots over control.

(2) *Robusta pruning* 1952.

The series of experiments started in Coorg at (1) Yemmigoondi, (2) Polibetta and (3) Cannoncadoo estates for the study of the effects of pruning on robusta were continued. The following were the treatments tried:

A Thinning out.
B Heading back.
C Control (no pruning).

'*Thinning out*' indicates removal of thin and weak branches and twigs which are less prone for cropping. This is done by the removal of those branches at their points of origin or at a place from where vigorous new shoots are expected to be formed. The object of thinning is to space the remaining branches and twigs to better advantage and to grow the plant generally to a desired shape and spread. The centring was done to a distance of 6 inches of the main stem.

Heading back: By this method, cropping of completely new wood instead of an extension growth of the current cropping branches is done. Just after the blossom, the terminal shoots are cut out beyond the last node with flowers. This stimulates new wood formation nearer the base of the cropping wood. When the crop is removed during the succeeding year, those parts of the branches which had borne the crop are cut off. The usual centring to 6 inches was also done.

There are no statistical differences among treatments.

6. Laboratory Work

A Plant Protection Assistant has been posted since 15.1.55

The main items of work taken up were the examination of soils from private estates for eelworms and rapid examination for lime and essential requirements of food material, specimens of plant material and pests and diseases reported by planters.

Cultures of parasitic fungi, *Cephalosporium lecanii* and *Empusa lecanii* were attempted. All samples collected during tours and at this Station contained both the parasitic fungi and separation of the one from the other was still under trial. A specimen was received of *Empusa lecanii* from Shevaroys and the culture of it has since been made.

During observations in the field about the incidence of the parasitic fungii on green bugs, it was sometimes noted that besides the two fungii mentioned above, there appears to be another orange red one which was sometimes taken for the white fungus, but on closer study it appears to be a distinct fungus. This fungus has also been brought into culture and is under identification.

Some brown scales on coffee in Massagode estate in North Coorg was found to have been parasitised by a fungus. This also has been brought into culture.

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Senior Liaison Officer.

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